

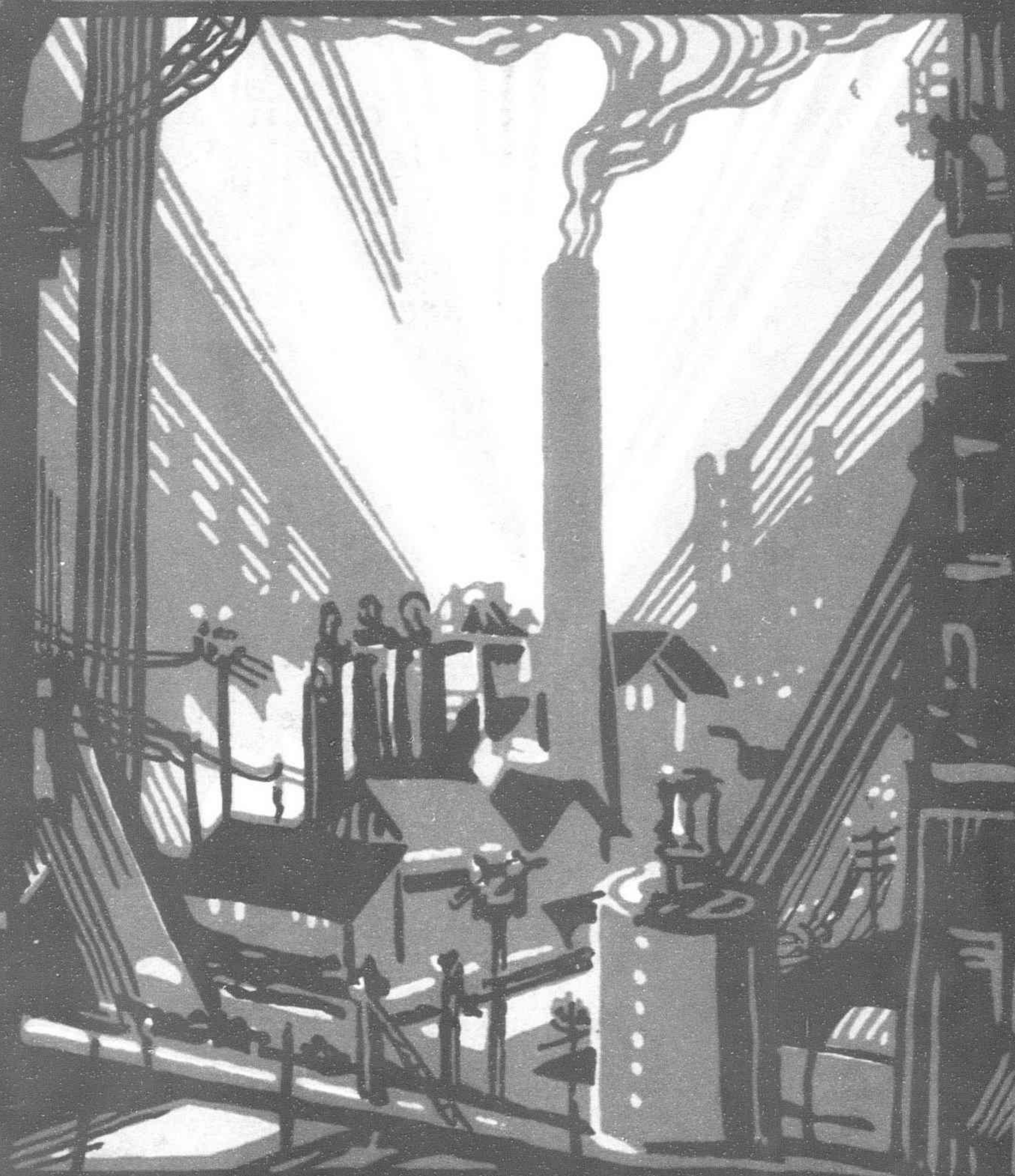
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JAPAN'S TRADE EXPANSION—ITS
EFFECTS ON AMERICAN INTERESTS

FOREIGN TRADE
By JAMES A. RABBITT

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No. 2

Japan's Trade Expansion—Its Effects on American Interests

By Dr. BEN DORFMAN, United States Tariff Commission, Washington, D.C.

(The following is a paper delivered at the Round Table Session of the Institute of Public Affairs, University of Virginia in July 1936).

THE spectacular recent expansion of Japan's foreign trade began in the latter part of 1932. By 1934, Japan had succeeded in advancing the combined yen value of her exports and imports above that for any preceding year subsequent to 1929. And by 1935, she succeeded in advancing it to an unprecedented level. In terms of gold value, however, Japan's foreign trade declined abruptly following 1931, and although it has risen slowly since, it is still considerably below its level for that year. Japan's relative share of world trade in terms of gold, however, rose slightly between 1929 and 1934. During this interval, her exports advanced from 2.9 per cent to 3.3 per cent of the world's total, and her imports rose from 2.8 per cent to 3.3 per cent. No wholly satisfactory data are available for measuring the changes which have occurred in the volume of Japan's foreign trade, but all evidence indicates that, while it declined somewhat between 1929 and 1930, it has since progressed rapidly, particularly in respect of exports. The increase in Japan's share of the world's foreign trade between 1929 and 1934 on a volume basis, therefore, is considerably greater than is indicated by the changes in its gold value. Nevertheless, Japan is still not responsible for any large fraction of the world's trade.

The expansion of Japan's foreign trade at a time when other countries were suffering contractions in theirs, provoked world-wide speculation as to the causes underlying Japan's trade success and the likely consequences it held in store for the economies of other trading nations. In view of the large interest but widespread misunderstanding concerning these two matters, I believe that it would be profitable for us to discuss some aspects of them here. First, let us consider the various factors which contributed toward Japan's trade expansion.

At the outset, may I point out that although a sharp increase in Japanese competition was not felt in world markets until 1932, Japan had been steadily enhancing her competitive position for some years previously. Much of the Japanese competition which has been felt during the past few years was destined to appear in any event, but due to a combination of exceptional circumstances which occurred during 1931 and 1932, its appearance was hastened.

One of the most conspicuous developments in Japan during recent years has been the progressive rationalization of her industry. The Japanese trade prosperity of the World War period was followed by a succession of natural and economic calamities—the earthquake of 1923, the financial panic of 1927, and the deflation of 1930 (following the removal of the gold embargo). Hard times forced the weaker enterprises into liquidation and impressed upon survivors, and the Government, the necessity for achieving a more efficient co-ordination in industry. Profiting from the experience of older industrial countries and aided by a paternalistic government, many branches of Japanese industry devoted their energies toward improving processes and technique, and reducing production and marketing costs. Within only a few years, the efforts began to yield significant results. In many fields, the hourly output of workers was increased, unit wage costs were reduced, and distribution expenses were lowered. The improvements were achieved generally as a result of increased efficiencies and not as a consequence of reducing workers' wages or wage rates.

Other Economies

Between the middle of 1929 and the end of 1932, it is claimed that Japanese cotton mills lowered their daily wage costs of operating spindles by more than 50 per cent. The costs of their weaving operations were likewise reduced, as a result of employing an increased number of automatic looms. Production economies were realized in rayon plants, woollen mills, coal mines, large-size porcelain factories, locomotive shops and a number of other enterprises which, for the most part, operate on a comparatively large scale; and marketing economies were achieved in these as well as in many smaller-scale businesses.

From what I have said, it is not to be supposed that all industries in Japan have increased their productive efficiency appreciably during recent years. In 1930, when the last census was compiled, nearly one-half of Japan's total working population was engaged in agriculture. Manufacturing employed a trifle over one-sixth of the working population; trade employed slightly less than one-sixth; and public services, the professions, fishing, mining, etc., the balance. The percentages represented by these occupational classes presumably are not much different at the present time. Only a fraction of Japan's workers, therefore, appear to have been engaged in those enterprises which have very greatly improved their productive efficiency during recent years. Japanese industry to a large degree is still in the hands of small-scale producers whose success has depended less on their increasing technical efficiency, than on their continued access to a cheap labor supply, extremely low "overhead costs," and the improving efficiency of their purchasing and marketing operations.

According to Japanese government statistics, less than 1,300 factories out of Japan's total of 68,000 in operation at the end of 1932, employed 200 or more operatives apiece. Over one-half of the total number, employed under 10 operatives each. Establishments employing less than five persons are not officially classified as factories, but such household units are believed to give employment to a greater number of workers than are employed in the so-called factories. Many goods which enter prominently into Japan's export trade, such as toys, fans, parasols, matches, sun-goggles, straw braids, knitted goods, potteries, etc., are the products of household industries. And with the exception of textiles, certain varieties of electrical and mechanical equipment, footwear, canned fish, etc., by far the major portion of the individual items comprising Japan's exports are the products of small-scale industry. The small number of the large-scale industries, however, provide a large fraction of the value of Japan's total exports.

Factors of Production

Japanese production takes place in establishments ranging from the household unit to the large modern factory. Efficiencies of operation, conditions of employment, etc., vary widely from industry to industry and from establishment to establishment. So far as general trends can be gauged, however, it appears that Japanese production, and buying and marketing technique, are tending to become more efficient. In so far as this is a factor operating to reduce Japanese costs of exports, it will serve to enhance Japan's competitive strength in foreign markets.

Rationalization, therefore, has not only contributed to the success of Japanese export industries in the past, but will tend to contribute to their success in the future.

A second important factor contributing toward Japan's trade expansion has been the availability of an abundant supply of inexpensive and relatively efficient labor. During recent years the number of workers has increased rapidly and, where modern equipment and methods have been employed, their productivity has likewise advanced. Despite this increase in efficiency, employers have been under no great pressure to increase wages, because the supply of labor has been redundant and workers have never been strongly organized. In the small "factories" and household industries, keen competition has compelled the workers and many of the entrepreneurs to be content with earnings only sufficient to satisfy their exceedingly simple wants.

Contrasts in Conditions

The monetary wages and working conditions which prevail in Japan are not directly comparable with those which prevail in Western countries. From the standpoint of the Japanese worker, his or her lower wages, longer hours of work, and fewer days of rest, as compared with Western workers, are partly offset by annual bonuses, retirement allowances, provisions for ill health, a more leisurely pace of work (but not in all industries) and, for certain classes of workers, dormitory accommodations, meals provided at nominal charges, free entertainment and the like.

The work day in Japan is somewhat longer than that which generally prevails in the West. Employees in large mills, for example, work from eight to 11 hours a day and obtain from two to four rest days per month, in addition to a number of holidays during the year. Workers in the smaller factories and the household industries generally work longer hours and enjoy fewer days of rest.

Japanese monetary wages, even when adjusted to include the value of the various supplements—which probably *average* about five per cent of the wage payments in the manufacturing industries as a whole—do not provide any satisfactory basis for comparing Japanese and Occidental living standards. The Japanese standard of living, moreover, is not as "low" as is generally thought in the United States (Japanese labor conditions are often confused with Chinese labor conditions). Japanese wage payments, when expressed in terms of United States currency, are likely to convey the impression that a Japanese receiving the equivalent of say \$0.50 a day is compelled to live as would an American receiving an identical wage in the United States. Such, however, is obviously not the case. According to recent Japanese government studies on living costs, a monthly expenditure of ¥45 (about \$13 at present or \$22.50 at the former mint parity) will sustain a working class family, consisting of two adults and two small children, at the margin of "decent subsistence." This scale is made possible because of the simplicity of the Japanese mode of living. Rice, fish, soy bean curd, and vegetables—all obtained within the Empire—constitute the essentials of the diet. Living quarters are small, because one room serves for several purposes. The sitting room is often a dining-room and bedroom as well. The Japanese sit and sleep on matted floors and consequently require but little furniture. The wardrobe is correspondingly simple. However inadequate such a mode of living might appear to a Westerner, the Japanese regard it as quite satisfactory. It would appear, therefore, that the Japanese standard of living might more properly be regarded as being "different" from the Occidental than as being "lower," and more properly regarded as being "inexpensive" than as "low."

The monetary wages paid in Japan, not only fail to provide a satisfactory basis for comparing Japanese and Occidental standards of living, but they are even less satisfactory as a basis for comparing unit wage costs. The lower wages and longer hours prevailing in Japan, as compared with those found in the more industrialized Western countries, do not combine to give Japanese producers the all-around competitive advantages in foreign trade which it is often urged they enjoy. With the possible exception of those Japanese engaged in the production of textiles, it is doubtful that any substantial number of Japanese workers employed in the export industries have, as yet, attained the productivity of similarly engaged workers in the more industrialized Occidental countries. Low wages no doubt provide Japanese industry with an extremely important competitive advantage in foreign trade, but it is an

advantage which is offset in varying degree by the lower productivity of its labor.

Effects on Rural Population

Japan's industrial workers on the average, it appears, have not suffered any large shrinkage in their real incomes during recent years, but Japan's rural population has suffered tremendously. This situation has arisen out of natural calamities, burdensome taxation, low rice prices, and the decline in the price and volume of silk consumed in the United States. In so far as the poverty of her rural areas facilitated the recruiting of laborers for Japan's factories and household industries, it indirectly contributed toward sustaining or increasing Japan's international competitive position.

It is impossible to forecast, with any degree of accuracy, the extent to which Japan will continue to enjoy competitive advantages in international trade by virtue of her comparatively low wage costs. It seems likely that, for the immediate future, however, she will continue to enjoy them. Since Japan's working population is increasing at a rapid pace and since organized labor is not strong, Japanese employers—who are well organized—are in a position to keep wages at low levels.

A third factor which has been of some importance in enhancing Japan's international competitive position has been the extension of government subsidies. The Japanese government for many years past has been highly paternalistic in fostering the development of industry and trade. In addition to direct grants, it has provided numerous indirect subventions, many of which can scarcely be distinguished from normal administrative expenses. It has rendered assistance by granting loans at low interest rates, by endowing research undertakings, by guaranteeing export credits, by extending preferential rail rates, etc. The Prefectural governments have also contributed small amounts for similar encouragements.

It would be exceedingly difficult to determine, even roughly, the aggregate monetary value of the direct and indirect aids which the Central and Prefectural governments in Japan have rendered industry and commerce. And it would be even more difficult to determine what fraction of this value ought to be assigned to the encouragement of Japan's export trade. So far as the direct aids to all industry and trade are concerned, it would appear that they have not been so extensive in scope or so lavish in amount as to account for any large fraction of Japan's recent commercial success in world markets. The chief beneficiaries at the present time are shipping, armaments (research), aviation, chemicals and dyestuffs, iron and steel, fisheries, the motor industry, and gold and oil production. The aggregate amount of direct Japanese subsidies is not large, and when spread over all Japanese trade and industry, is exceedingly small. With the exception of shipping, moreover, no Japanese business which offers serious competition to important American interests at the present time appears to receive large amounts of government assistance. With respect to shipping, it may be observed that the American industry, as well as those of many other countries, have likewise been the beneficiaries of government subsidies. Similarly the indirect aids which Japan extends to the fishing industry, for example, are paralleled in greater or lesser degree by those extended the same industries in other countries. The widespread notion that Japan's export industries depend wholly or very largely on government aid for their existence and would collapse without it, cannot be substantiated. Most of Japan's subsidies have been well directed rather than lavish.

I have now considered three of the principal "long run" factors which have operated to improve Japan's competitive position in foreign trade—rationalization, low wages, and government aid. Another factor, which is frequently ignored, is the pressure which was being exerted upon Japan to increase all possible exports in consequence of the drastic fall in the price of raw silk, formerly her chief export.

Changing Trade Conditions

For the decade preceding 1930, raw silk usually accounted for over one-third of the total value of Japan's exports. During the latter part of this period, raw silk prices began to decline, due both to the increased production of silk within Japan and the increasing world competition from artificial silks. The downward trend of silk prices continued, even after Japan abandoned the gold standard at the end of 1931, with the result that by 1934, raw silk accounted for only 13 per cent of the value of Japan's total exports.

The fall in the price of silk, I believe, was a very important element in compelling Japan actively to seek other means of paying for her imports. This served to increase Japan's imports of many materials, and a number of these were obtained from the United States. Silk prices have improved somewhat more recently, but they are still considerably below the high levels of earlier years. Japan, therefore, still remains under considerable pressure to push her other exports.

Earlier, I spoke of certain exceptional circumstances which arose in 1931 and 1932, which served greatly to increase both the ability and need of Japan to expand her foreign trade. The most important of these was the depreciation of her currency at the end of 1931.

It has frequently been charged that the principal reason for Japan's depreciating her currency was to gain trade advantages over other countries. The Minseito Government, which was in power when Great Britain departed from the gold standard in 1931, bitterly opposed Japan's following suit. When Japan did depart from the gold standard in December, 1931, however, she permitted her currency to depreciate to a greater degree than Great Britain had, or the United States was to, subsequently. Considerations of trade, no doubt, influenced the extent to which Japan permitted the yen to fall in relation to other currencies, but its course was dictated in large measure by forces over which the Japanese Government at that late date exercised little control. Japan, moreover, did not feel that it was to her own interest to allow the yen to depreciate unduly, and from time to time adopted various measures calculated to check its decline. While a low yen facilitated exports, it imposed additional burdens in paying for imports and in servicing foreign loans. Japan's imports regularly exceeded her exports; and on foreign loan and investment accounts, her out-payments regularly exceeded her in-payments.

As circumstances turned out, the marked decline in the external value of the yen—or rather the marked external undervaluation of the yen—served to enhance Japan's competitive position in international trade to a greater degree than any other of the contributing factors. Japanese exporters were enabled to sell their goods in foreign markets at lower foreign currency prices than before, while receiving the same or even a higher price for them in terms of yen. It is true that after the considerable stocks of imported raw materials purchased at pre-devaluation prices had been consumed, Japanese exporters were obliged to increase the prices of their exports where these embodied imported materials. But they were not obliged to increase them to the extent that the foreign exchange value of the yen had declined, for many of their production costs showed only a slight response to the external fall in the value of the currency. Wages, for example, did not rise; in many cases, they even declined. This is explained largely from the fact that the bulk of the Japanese workers' requirements was met by goods produced within the Empire.

Trade Expansion Elements

It is frequently contended that if Japan had not depreciated her currency, she would never have been able to expand her foreign trade to the extent she has. Possibly this is true. But the fact that she has not even yet lost the competitive advantages which the decline in the yen seemingly gave her, suggests that Japan's trade success has rested on more enduring forces than those which could possibly arise out of currency depreciation. All evidence indicates that even if Japan had not depreciated her currency she would have been able, and would probably have been obliged, to expand her foreign trade by means of a severe and an exceedingly painful deflation of internal prices. If Japan had undertaken to increase her foreign trade in this manner, it would not have expanded with the suddenness it did and it probably would not have attained the height it has, but it nevertheless would probably have increased very substantially. Too great an importance, I believe, has been attributed to the depreciation of the yen as an independent factor contributing toward Japan's trade expansion. If this expansion had rested principally on the fleeting and dubious advantages which arise from currency depreciation, Japan would quickly have lost them. Japan's recent trade expansion, I believe, is to be credited more to those "long-run" forces and pressures, which I have already described, than to those which were generated by her abandonment of the gold standard.

In addition to the devaluation of her currency, several other short-run factors also contributed to the expansion of her export

trade. The prolonged world depression increased the demand for cheap wares, large numbers of which Japan was in a better position to supply than any other country. Any many foreign importers of toys, novelties, and specialty goods have turned from Germany to Japan for their requirements because they were attracted by extremely low prices, or because they wished to refrain from buying German-produced goods. Japan's military operations and investment program in Manchuria and North China have also tended, both directly and indirectly, to promote her trade expansion. Japan's activities in these areas have themselves been responsible for the export of much Japanese goods, and the cost of her program has, in part, been sustained by the export of goods to other areas.

I have now briefly discussed the principal factors which contributed toward the expansion of Japan's foreign trade. How has this expansion affected the economic interests of the United States?

The United States and Japan are each important customers of the other. During recent years, Japan has ranked third among our principal world customers and second among our chief foreign suppliers. Only the United Kingdom and Canada have surpassed her as customers, and only Canada as a supplier. The United States occupies even a more predominant position in Japan's foreign trade. In recent years the United States has been Japan's chief foreign supplier and, until 1934, was Japan's largest customer. In that year, the United States dropped to second place as a buyer of Japanese goods, being outranked by China inclusive of Manchuria and the adjoining Kwantung Leased Territory.

Shifting Balance of Trade

For many years prior to 1922, Japan's sales to us greatly exceeded her purchases from us. Since 1932, though, we have been selling much more to Japan than we have been buying from her. This shift in the balance of trade between the two countries resulted from a number of factors; but chiefly from (1) the sharp decline in the price of silk and (2) from Japan's sustained purchases of American materials which she has been embodying in her exports, principally to other markets.

Prior to 1932, raw silk was Japan's most important export. It accounted for as much as 25 per cent of the value of her total exports, and for as much as 85 per cent of the value of her aggregate sales to the United States. The United States, moreover, generally purchased over 95 per cent of Japan's exports of raw silk.

Silk prices commenced to decline in 1925. In this year, silk sold in the United States for \$6.57 a pound; in 1934, it sold for \$1.29 a pound. The shrinkage in silk prices, probably more than any other single factor, has been responsible for Japan's efforts to expand her sales in other commodities. The expansion of her sales in other commodities, however, required her to import substantial amounts of materials out of which to fabricate them. And she has been purchasing a number of these materials from the United States.

At the same time that Japan's balance of trade with the United States changed in 1932, her balance of trade with the aggregate of the other countries of the world also changed. Since then, Japan has continued not only to buy more from us than she has been selling to us, but to buy less from the other countries of the world, in the aggregate, than she has been selling to them.

Raw silk and raw cotton occupy such predominant positions in our trade with Japan that the variations in their respective values from year to year, have in large measure been responsible for the variations in the total trade between the two countries. Both raw silk and raw cotton prices declined sharply between 1929 and 1932. But while cotton prices began to increase in 1932, silk prices—in terms of dollars—continued to decline. In 1929, it required 26 pounds of cotton to buy one pound of raw silk; in 1934, it required only 10 pounds of cotton to buy one pound of silk. The changes in the total values of the silk and cotton entering into our trade with Japan, during recent years, have reflected not only the changes in unit prices but also the changes in the volumes traded. In comparing our trade for 1934 with that for 1929, we find that, while Japan bought a larger quantity of cotton in the later year than in the earlier, we bought a lesser quantity of silk in the later than in the earlier year. Japan has reduced the annual volume of her cotton purchases from us since 1932; but she is still buying more from us than she did before the depression. Our other major world customers for cotton have so reduced their volume of purchases

since the beginning of the depression, that Japan now ranks well above any of them.

If we consider our trade with Japan in commodities other than silk and cotton, we find that our exports have regularly exceeded our imports. During 1934, our other-than-cotton exports were almost the equivalent in value of our total imports from Japan, inclusive of silk.

In terms of American currency, our exports, exclusive of cotton, and our imports, exclusive of silk, declined yearly between 1929 and 1932, and then rose again commencing in the following year. But our other-than-silk imports since 1932 have not been rising nearly as rapidly as our other-than-cotton exports. In other words, although we have in recent years been increasing the value of purchases from Japan in commodities other than silk, we have, to a much greater degree, been increasing our sales to Japan of commodities other than cotton.

Factors of American Trade

In a recent government report, dealing with our trade with Japan, there appears a detailed analysis of our 1934 imports. Over 71 per cent of them, on a basis of value, entered the United States free of duty. Raw silk accounts for a major fraction of their value; but a number of other non-dutiable commodities are also of importance—tea, pyrethrum, undressed furs, perilla oil, rapeseed oil, camphor oil, vegetable wax, rags, platinum, silk waste, etc. For the most part, these duty-free commodities are not similar to any produced within the United States, and they supplement, rather than compete, with American products. The dutiable imports, however, compete in varying degree with American-made goods.

In the government survey to which I referred, there appears a list of every import into the United States from Japan which amounted to as much as \$1,000 per month on the average for the year 1934. In the aggregate, these imports accounted for almost 99 per cent of the value of our total imports from Japan, and the dutiable imports appearing in this list accounted for about 27½ per cent of the total imports. But not all of these dutiable goods may properly be considered competitive with American-made goods. There is no domestic production of goods of the kinds represented by over one-fifth of the total value of these dutiable imports.

The domestic production of certain of the others is insufficient and would not likely increase appreciably even in the absence of the imports from Japan. Still others are so different in type or grade from commodities produced in the United States, that they may be regarded as only slightly competitive. Another group embraces goods which, while competitive, constitute only a negligible fraction of the total of such goods produced or consumed in the United States. The imports from Japan which would be regarded as competitive to a substantial degree with domestically produced goods, amounted to slightly more than eight per cent of the value of our total imports from Japan in 1934. Most of the Japanese goods, against which formal complaints have been lodged with our government, fall in this category.

The list includes varieties of frozen and canned fish, floor coverings made of cotton or wool, or other specified materials, wool knit gloves, tennis shoes, cotton cloth, earthenware, china, electric lamps, toothbrushes and hairbrushes and component parts, dolls and toys and combs made of cellulose, manufactures of bamboo or wood or bark, velveteens, cotton hose, cotton fish netting, baseballs, footballs, ping-pong balls, mechanical pencils and thermos bottles. Our government has already taken restrictive action affecting over one-third of the aggregate value of these imports, and investigations are pending on a small fraction of the remainder. The Japanese Government has also taken action to restrict the export of certain of these goods to our market. And, in a number of other instances, the American consumption of the Japanese goods has been declining, either absolutely or in relation to domestic production. Only a small fraction of our total imports from Japan, therefore, are represented by goods which have been offering increasing competition to American-made goods and against which no restrictive action has been taken by our Government.

Benefits Not Lacking

In considering the benefits which domestic producers receive when restrictive action is taken against competing imports, sight should not be lost of the injury which such action generally inflicts

on other American interests. Japan's trade expansion has conferred substantial benefits upon the general consuming public in the United States, in that it has enabled them to buy a variety of Japanese products at low prices, as well as a number of domestically produced goods at prices which have been lowered only because of Japanese competition. Whenever restrictive action is taken against imports, therefore, the domestic consumer is generally injured. And, likewise, but less directly, certain export interests, particularly those catering to the Japanese market, are also injured.

Let us now consider the composition of our exports to Japan. As I explained earlier, Japan has, in recent years, increased the value of a number of her purchases from us besides cotton. Comparing her imports from us for the years 1929 and 1934, we find increases in wood pulp, crude petroleum, gas and fuel oil, calf and kid skins, iron and steel scrap, aluminium, refined copper, brass and bronze, motor trucks, buses, automobiles, and automobile chassis, phosphate rock, and fertilizer material. In the case of a number of other commodities for which the United States is an important supplier, Japan reduced the value of her imports during this same interval. Among these commodities are cattle hides, wheat, rubber tire casings, rosin, leaf tobacco, cedar logs and timber, fir and hemlock boards and planks, gasoline, kerosene, lubricating oil, wire rods, steel sheets, tin plate, welded black pipe, lead, and automobile parts. The items I have mentioned, constitute about 90 per cent of our total exports to Japan for 1934, and about 80 per cent for 1929. Our other exports to Japan consisted principally of various kinds of machinery, electrical equipment, iron and steel products, and timber and lumber. In some cases, where Japan's purchases from us in 1934 were lower than for 1929 they, nevertheless, showed recoveries from the 1931 levels.

The most pronounced increases in our export trade to Japan have been in those unmanufactured and partly manufactured materials, which Japan has been embodying in her exports to other markets. Japan's trade expansion, therefore, has served to sustain or improve the demand for a number of American export goods. It may be argued that, if Japan had not taken these exports, some other countries would have. To a degree, this is doubtlessly the case. But, due to the low prices at which Japan has been selling many of her exports, the world consumption of American materials embodied in them has been sustained at a higher level than would likely have been the case had Japan not expanded her trade. On the whole, therefore, Japan's trade expansion has benefitted the American export interests catering to the Japanese market. But how has it affected the American export interests catering to other world markets?

The chief areas in which American export interests have been adversely affected by Japanese competition, are Latin America and the Philippines. In both these regions, the keenest competition has been felt in cotton textiles, although rayons, rubber-soled footwear, canned fish, electric lamps, enamel ware and cutlery have also been of importance.

In so far as Japan's expansion in aggregate sales to Latin America is concerned, it has been spectacular only in terms of percentage gain—particularly so, when comparisons are made between the gold yen values of Japan's 1931 exports and the depreciated paper yen values of her exports for subsequent years.

Latin American Trade

Prior to 1934, in which year United States sales to Latin America began to show some improvement, the increase in Japanese sales in this market was accompanied by a severe decline in American sales. Japan's relative gains, however, constituted only a small fraction of United States relative losses. For example, Japan supplied the 12 principal Latin American countries with 0.6 per cent of their total foreign purchases in 1929 and with 1.6 per cent in 1933; whereas the United States supplied them with 37.4 per cent of their total foreign purchases in 1929 and with 26.3 per cent in 1933. It does not appear, therefore, that United States general decline in exports to Latin America is to be attributed in any appreciable degree to Japan's trade advance there. The decline has, in fact, been due to the exceptional shrinkage in purchasing power in these areas and to the competition of countries other than Japan. During 1934, incidentally, the United States sold 308 million dollars worth of goods to Latin America against Japan's sales of 31 million dollars. The increase in United States sales to Latin America in this year over the preceding year's sales, was

alone three times as large as Japan's total sales there during 1934. Compared to the United States, Japan still remains a small factor in Latin American trade.

The absolute increase in Japanese sales in the Philippine Islands has been accompanied by a decline in American sales there. In terms of relative values, however, United States participation in the Philippine import trade has been only slightly affected by the Japanese increase. Although Japan supplied a larger percentage of the Philippine's total imports in 1935 than in any preceding year, the United States also supplied a larger percentage in 1935 than it had on the average for the preceding decade, when its relative participation in the Philippine market was at its height. United States relative share in this market declined slightly between 1934 and 1935; but in 1934 its share was the highest on record. Japan's sales expansion in the Islands, up until last year, was accompanied by relative losses sustained primarily by China, Great Britain and the Dutch East Indies, and not by relative losses sustained by the United States. In 1935, however, Japan's further expansion was accompanied by a slight decline in the share of imports supplied by the United States. The Philippines, however, still buy the major portion of their imports from the United States. In 1935, we supplied them with over \$54,000,000 worth of goods or almost 64 per cent of their total imports, whereas Japan supplied them with \$12,000,000 worth, or a little over 14 per cent of the total.

United States' most serious shrinkages in export trade have occurred in its large European and Canadian markets. Of our total

exports during recent years, Europe has taken from 45 to 90 per cent and Canada approximately 15 per cent. Since Japan has never been an important supplier of goods which compete with American-made goods in either of these markets, the curtailment of our sales there cannot be attributed to Japan's recent trade expansion.

It appears that, for the most part, the United States and Japan specialize in different types of exports, and that each country caters principally to different markets. The recent expansion of Japan's export trade, therefore, has not been a major factor affecting the aggregate value of United States exports to world markets outside of Japan. The increase in Japan's sales in these areas, has primarily affected other exporting nations.

I have now discussed, at some length, the manner in which Japan's trade expansion has affected various American interests. You may wish that I should evaluate these losses and gains from the standpoint of our national interest as a whole. Unfortunately, I know of no way to formulate such an estimate. In any case, a more pertinent question relates to the probable consequences of the courses of action we might pursue in dealing with Japan's trade expansion. In this connection, it is important for us to appreciate that Japan's trade expansion is a fact which the United States, by itself, is in no position to modify appreciably except at a loss to itself. It is extremely doubtful, therefore, that the indiscriminate raising of barriers on imports from Japan would redound to our national interest.

Foreign Trade

By JAMES A. RABBITT

(The following is an address that was delivered by Mr. Rabbitt before the American Mining Society in New York last July. Mr. Rabbitt is Adviser and Acting Director of the Japan Nickel Information Bureau at Tokyo.)

To try to tell all about foreign trade in ten minutes would be like trying to force the waters of Niagara through the neck of a bottle. I shall speak only about the recent development of Japanese trade and industry, because I believe we can do much good by taking a balanced view of Japanese trade. By balanced view, I mean the fair view.

This can be illustrated by the story of the old colored man who, when asked for his opinion on a question, said: "What fo' you all want my opinion—don' you all know they's three sides to every question?" When asked what he meant by three sides, he replied: "Fust they's yo side; second they's my side; and then they's the right side."

Now I believe that the fair view is a balanced view because it is always searching for the right side. So I propose to divide my subject into three parts:

- First, the general adverse criticism of Japanese trade.
- Second, how the Japanese produce and sell so cheaply.
- Third, what their trade amounts to in dollars and cents.

There is nothing new in the alarm over the advent of a new star in the firmament of international trade. In the early nineteenth century our own young nation upset Great Britain and Europe with our export of cheap gim-cracks, which were derisively called "Yankee notions," and even to-day we have our American five and ten cent stores in England. Later the whole world trade feared an upset because of the deluge of cheap products marked "Made in Germany." When I went to Japan thirty-four years ago to introduce American machinery we were accused by our English cousins, who had the lion's share of the business there, of Yankee dumping.

Even in our own domestic trade—before the days of live and let live—a newcomer in any field was looked upon with suspicion by those who were in on the ground floor of an industry or trade. But to-day we now move a little closer together and make room for the other fellow; this spirit is beginning to permeate the world. Why not apply this balanced view to Japanese trade?

How does Japan produce and sell so cheaply when she has practically no raw materials?

The Japanese have rationalized their industries by careful surveys and have so organized themselves that they can concentrate the co-ordinated effort of the entire nation on selling what they have to sell, and that is: *power and labor*. The power of the land is abundant, and four-fifths of it is hydro-electric. The country, as you know, is mountainous in the central regions, with an ample rainfall to maintain a good watershed throughout the year.

Those who have developed this water power are co-operating with the rest of the nation by not exploiting their own people with their power privileges. This is important to remember, as the low cost of Japanese products throughout is due largely to this spirit of co-operation and co-ordination among the people of Japan.

How About Labor?

We hear much about the low price of labor, and the so-called low standard of living in Japan. The first step in obtaining a balanced view of this subject is to remember that the Japanese form of civilization is simple, while ours is complex. Socrates said that the height of civilization could be measured only by the simplicity of life: the Romans said that civilization could be measured only by roads, sewers and laws; and we don't say anything, but we know that our form of civilization is the most complex the world has ever known.

Our workers enjoy sanitary equipment, transportation and food which were unknown to the kings and queens of Europe up to the nineteenth century. Hence we are prone to call a standard of living low when it is only simple.

The Japanese unit of currency, the yen, is as dear to them as our dollar to an American, though its comparative value is only twenty-nine per cent. The Japanese worker can purchase as much of the necessities for his needs for subsistence with his yen as our workers can with our dollar. Hence we start right here with a reduction of almost three-quarters on the cost of labor.

Next, through the simplicity of life in Japan—including food, clothing and housing—there is not the need for the purchase of so much paraphernalia to attain happiness as is required in this country. We must not forget that our grandfathers did not think

they were victims of sweated labor when they had only the Bible for reading and "shank mares" for transportation, houses which they built with the help of their neighbors, and clothes made from cloth woven by their women folks.

There is still a sylvan simplicity in most parts of Japan—outside of the ports—where life goes on much as it did with our forebears.

Now, in order to search a little farther for the fair view of Japanese trade, let us ask what this trade amounts to in dollars and cents. The total production of all of the industries of Japan in 1929 was \$3,829,000,000, with 1,825,000 workers; which was approximately the same as the total production in the industries of the U.S.A. in 1869 with 2,000,000 workers. The U.S. increased its industries by 1929 to 70 billion dollars, or an increase of twenty times, with an increase of labor of less than five times. Further, to get a balanced view we should consider the following: The value of the total industrial production in the State of Illinois alone during 1934 was \$3,528,946,000, practically the same as that for all of Japan.

Next, let us keep in mind that the total budget for the Empire of Japan for the present fiscal year is about \$643 million, while

the budget for the city and county of New York for 1935 was \$553 million.

Finally, let us consider our own trade balance with Japan. According to the U.S. Department of Commerce figures for 1934, we purchased from Japan 399 million yen worth of goods and sold to Japan 769 million yen worth—in other words, they took from us almost twice as much as we took from them. In the same year we purchased from Japan \$70 million worth of silk and we sold Japan \$112 million worth of cotton.

During the same year, 1934, Japan exported to this country \$49 million worth of miscellaneous goods—some of which brought down wrath upon them—while we sold Japan during the same period \$98 million worth of miscellaneous goods, which caused no comment.

Now I wish to ask: Why this "tempest in a teapot"? The whole business reminds me of the illustration once given by the famous Henry Ward Beecher in one of his sermons:

"Two boys ran to steal a ride on the back of a carriage. One caught the vehicle; the other failed, and then shouted to the driver, 'Cut behind.' Are we going to shout 'Cut behind' because Japan is hitching a little ride on the international trade coach?"

Engineering Development in China

By Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E., Taikoo Professor of Engineering in the University of Hongkong, in "The China Press Weekly"

To the English engineer China appears as a submerged continent newly upheaved from the ocean of time. On its vast extent he sees many opportunities for the development of greater natural resources.

In India and Egypt engineering works have increased the standard of life for millions of the natives. The Anglo-Saxon, with only a superficial acquaintance with China and its industrious inhabitants, is amazed at the primitive methods employed in native industries and in transportation. He is appalled by the waste of human energy and the terrible poverty of the vast majority of the people; he wants to change conditions which he knows are mainly due to ignorance of the laws of Nature and modern mechanism, and which produce starvation and untold misery. There are countless ways in which science can improve the health and increase the wealth of the people in China.

The salvation of a nation, as of an individual, comes from within, but the knowledge that creates regeneration must be acquired from teachers. More than thirty years ago it was my privilege to listen to an inspiring address given by a great engineer, Sir Alexander Binnie, father of the designer of the Shing Mun dam. He attributed the rapid industrial progress in England, and the numerous inventions produced there in the 18th and 19th centuries, to the knowledge gained from foreigners in previous years.

With the example of the rapid development of Malaya, Hongkong and Japan, due to the instruction and advice of foreigners, before their eyes, our Chinese friends will surely seek help from engineering experts who have had the experience essential for safe and efficient work.

A fact that makes me sanguine of the future in China is the astonishing sudden and complete change in the mental attitude of the Chinese intellectual and political leaders concerning the value of engineering works. Where, in my experience, there was blind opposition and a contempt for applied science in official and scholastic circles, there now is anxiety to proceed with practical schemes. Let me quote the words of the two leading Chinese, who are not engineers.

"I wish to tell our foreign friends in plain words," said President Chiang Kai-shek recently, "that the economic reconstruction of China has now already passed its period of discussion and has entered the stage of practical application."

Dr. Hu Shih has written: "Modern technology is highly spiritual, because it seeks through human ingenuity and intelligence to relieve human energy from the unnecessary hardships of life and provide for it the necessary conditions for the enjoyment of life."

The political and intellectual leaders of China have turned their backs upon the old path that led only to the cul-de-sac of an arid and abstract philosophy, and have lunged forward with determination into the age of steel and electricity.

You have only to compare the conditions of life of the masses in England to-day with those that existed before steam was harnessed in 1765, and you will realize to what extent the new civilization will raise the standard of life in China.

The economist Sydney Webb has stated that the lower half of the social scale has benefitted more than the upper half by machine industry in Britain. Those of you who have experienced air conditioning, the latest and one of the greatest gifts of applied science to workers in the tropics, must realize that human efficiency can be increased by engineering devices. A new and a great industry is being created in Britain and the United States that will employ, especially, capital and labor and will have an immense influence upon the economic development of the tropics and the large areas affected by excessive humidity in China.

During the last two or three years startling events have happened in this part of the world: events that must have a tremendous influence upon the future of Hongkong and China. Yet you seldom read about them, or hear them discussed, for constructive work is not so sensational as wars, murders, and sordid stories.

Really Important Events

The events really important are: (1) the completion of the many thousands of railway track that runs right across Asia and Europe, joining by links of steel Canton and Calais; (2) the placing of Hongkong on the map as a great air-port, for passengers have come to this Colony through the ether, at tremendous speeds, from London, from San Francisco and inland cities of China; (3) long-distance talks between Hongkong and Shanghai, with the certainty of telephone communication between Hongkong and almost any European city, and daily reception of radio from London; (4) the triumph of mechanisation over cheap and efficient manual labor as demonstrated in the construction of the Shing Mun dam and the Hongkong Bank building; (5) the practical proof that an ideal atmosphere can be provided by machinery in offices, hospitals and homes; and that the results increase not only health, but the physical and the intellectual efficiency of people provided with manufactured weather.

In China three main divisions of engineering developments are now taking place. They are (1) Communications, including railways, roads, air services, telephones, radio, etc.; (2) the improvement

of waterways, irrigation and flood prevention works; (3) industrialisation, or the placing of power behind the worker, and the development of the natural resources of the country.

Progress in Communications

Consider land transportation. The total mileage of highways in China in 1920 was 600, and in June 1936 it was 140,000. You can now motor from Changsha in Hunan to Canton or Shanghai, and from Foochow to Hankow. In Chengtu, nearly 1,400 miles up the Yangtze, there is now a registration of 1,000 motor vehicles.

Twenty-five years ago I described Canton as "a city of a million people and the city without a wheel." To-day Canton has wide roads, efficient traffic police, and power vehicles, like any European city. The Commercial Attaché to the U.S.A. Embassy in China says there is more reconstruction going on in the cities of China than in any other country in the world.

The completion of the Canton-Hankow railway this year by Chinese engineers is an event of world-wide importance. But this is by no means the only new railway construction going on in China. The oldest lines run roughly North and South, but the new lines in construction and planned run mostly from West to East, thus opening up interior provinces. Wide rivers and high mountains present unusual difficulties and add greatly to the cost. Gigantic bridges, long tunnels and difficult surveys are needed.

The need and the demand is for more railways and yet more railways in China. Only a fraction of the total length of the lines planned by Sir Macdonald Stephenson for China in 1865 has been built. Less than ten per cent of the length of lines demanded by Dr. Sun in the first year of the Republic is available. In India there is a mile of railway for every 8,000 people and 44 square miles; in China there is only a mile of line for every 70,000 people and 300 square miles.

Roads are of value, but cannot replace railways in any country. The main difficulty about railway construction in China is finance; when that is overcome there will be a very great increase in railway construction. Properly managed, almost any form of mechanical transport is profitable in densely populated areas. An English expert has said that railways could produce a revenue for the Chinese Government equal to that obtained from the Maritime Customs Service.

Commercial aviation has made great progress. China is becoming air-minded; planes are now operating with frequent schedules between important cities. In eight hours they cover nearly 1,400 miles between Shanghai and Chengtu. You can leave Nanking and arrive in Canton six hours later.

The Government has realized the value of telephones for military and unification purposes. Great extension in the services, especially in Central China, have recently been made. There are automatic telephone exchanges in Canton and other Chinese cities.

Radio, in the Chinese and English languages, can be heard in remote villages. Its value for unification purposes cannot be over-estimated and is realized fully by the Government.

China's Most Urgent Problem

To-day inland water-borne traffic greatly exceeds in volume that on roads and railways combined. For centuries the highways of China were the waterways. Goods were carried by river and canal from Canton to Peking, a distance of nearly 1,400 miles, except for the transport over the mountains north of Kwangtung, where coolies carry them on their backs for 30 miles to a Yangtze feeder. The Grand Canal of China, 1,000 miles long, remains the greatest example of that type of engineering construction in the world. I am inclined to believe that the waterways present the most urgent and the most important engineering problems for solution in China.

The Yellow River is known as "China's Sorrow"; but other waterways have inundated and destroyed millions of acres of crops and caused terrible misery in large districts. Although in my time there have been tragedies produced by indifferent river conservation in the South, the results have been almost trivial as compared with those experienced in North and Central China. Few people in this part of the world realize what the failure to control their waterways has cost the Chinese nation.

In 1935 the Yellow River burst its banks and took an entirely new course, forming a river 400 miles long and from half a mile

to 50 miles in width. About 450,000 square miles of farming land was flooded and millions of people were rendered homeless. A correspondent in North China wrote as follows: "The breach in the banks through which all this water poured was 2,000 meters long. It is estimated that \$2,000 would have strengthened this dyke originally, but that now it will cost \$5,000,000 to stop the breach, if ever it is done."

The Yangtze floods also have created terrible losses. This basin has a huge population of 180 million, while in the Yellow River basin there are about 100 million inhabitants. In the area affected by the third river system, that in South China, the population is 60 million. The Chinese Maritime Customs Report states that in 1935 the total loss caused by floods in China totalled \$450,000,000.

The more hopeful side of the picture is presented by a survey of the work done in recent years by various river conservancy organizations in China, but especially that accomplished by the Engineering Department of the China International Famine Relief Commission. The chief engineer, O. J. Todd, an American, deserves the admiration and the gratitude of every Chinese, and of every friend of China, for his long and gallant struggle against human inertia and deeply rooted corruption. Perhaps his greatest triumph is that his practical results have persuaded leaders in the nation and some provincial governments of China that the waterways can not only be controlled, but made of much more economic value.

Flood Prevention Projects

Twenty flood prevention projects costing \$1,600,000 were carried out a few years ago along the Yangtze and Han Rivers. An increased value of \$20,000,000 annually has been obtained in lands behind one dyke (Shih Show) since 1925. The new dyke did not fail during the unprecedented Yangtze floods of 1931. An engineering expert has written as follows:—

"The careful supervision by foreign engineers ensured a better quality of work than had previously been known." In other places "the people refused to follow instructions as to quality of work, size of section, height, etc. They insisted on a low factor of safety . . . as a consequence high water, in 1933, demonstrated to these people and officials that it pays to follow the advice of experienced engineers."

Practically all Government supervised dyke work in the region was inadequate. There is little need to mention irrigation, except to suggest that its value can be increased by conservation schemes and improved mechanism for pumping, etc.

Power-driven vessels of all types now carry passengers and goods to remote inland towns of China. In the Yangtze gorges we saw a hundred men hauling a junk up the rapids. We were travelling in a modern motor vessel; over our head was a plane. It took about four weeks to drag the junk by man-power from Ichang to Chengtu. It took four days in our vessel and four hours by plane. There is no more striking contrast between the old and the new methods of transport in China than can be seen in the giant gorges of the Yangtze.

Vague and grandiose schemes have been suggested for harnessing the rushing waters of China to provide electricity. Millions of horse-power run to waste annually; the idea of obtaining electricity without the cost of fuel is most attractive, especially to those ignorant of the many cost factors as important as fuel. The ignorant talk glibly of the Yangtze, but they do not mention that at Hankow there is, each year, a difference of 40, and at times 100, feet between the lowest and highest levels of the river.

Of course there are great possibilities of water-power development in China, but there are many more urgent and profitable hydraulic works demanding attention. The grandiose schemes require not only large sums of money for dams, etc., but they need huge industrial centers to consume electric power. In our generation, except in a very few cities, which are hundreds of miles from suitable hydro-electric super-power station sites, electric power will be provided in China by comparatively small isolated plants. Not the huge rivers but the smaller tributaries, offer the best promise of making use of the "white coal" in China in the immediate future.

The great increase in the size of ships, and in the volume of shipping calling at ports in China, has provided many unusual problems for harbor engineers. Remarkable schemes have been successfully carried out.

Whangpoo Conservancy

The incredible has been accomplished by Dr. Chatley and the engineers of the Whangpoo Conservancy Board; the shallow river bed has been converted into a safe harbor, so that large ocean-going steamers now lie close to the Shanghai Bund. Every year the Yangtze carries down an enormous volume of sediment, about one-half of which is added to the coast, sufficient to form an island one mile square and 90 feet deep. That fact complicates the harbor problem in Shanghai.

Grouped around that man-made harbor are numerous factories and about three million people. Shanghai is at once the Manchester and the Liverpool of China and bids fair to become the largest industrial center in the world. The amazing growth in the demand for electric power tells its own story.

Industrialisation in Shanghai has developed in recent years at a rate exceeding that of any other city in the world. The Shanghai Power Co. state that they are supplying 232,000 h.p., say 175,000 k.w., for industrial requirements only. In 15 years (1915-30) the annual output jumped from 5 million units to 650 million units.

Kwangtung province will demand more and more power. In Canton the maximum load in the power stations jumped from 2,000 k.w. in 1916 to 25,000 in 1935. A new plant of 30,00 k.w. is nearly completed. A grid system for Kwangtung, properly managed, would be a most profitable concern.

No one country or continent is any longer the home of modern industry or its sole focal point; the finest work in rapid motion picture photography has been done in Japan, and the most astonishing instrument of cheap mass production is the Bata shoe factories of Czechoslovakia; already the textile mills in Shanghai are competing with success in the markets of the world.

Although the power era has commenced in China, there can be seen to-day countless examples of the waste of human energy. Coolies transport loads of 180 lb. on their backs. They carry those loads 15 miles a day for 750 miles at 17 cents a day—less than 3d. Wheat can be shipped from Seattle to Hankow, nearly 7,000 miles, for less than half what it costs to ship it from a town in Shensi to Hankow, a distance of 600 miles; eggs in Shensi sell at one-third their price in Hankow.

For nearly a century Hongkong has been an object-lesson to our Chinese friends of what can be accomplished by engineering science and Anglo-Chinese co-operation. Mechanisation has recently been proved to be more economical than manual labor. The Tytan Tuk dam was built entirely by manual labor in six years. The Shing Mun dam, three times as big, was completed in five years owing to mechanisation.

There is no time to talk of water supply, reclamations, the new architecture, etc., but you may expect me to say something about the mineral resources of China. Why do I hesitate? Ten years ago men died of despair in Manila because they believed their time and money had been wasted in the gold-mining industry, which they then thought had been over-estimated. To-day we know it was under-estimated in magnitude and value.

There is a certain amount of data about minerals in China that warrants much more rapid development than is taking place. But nobody knows what mineral deposits, at present unsuspected, lie beneath the soil. No one mentioned oil in Texas 50 years ago. All that we can say is that there is available much mineral wealth in China, but modern methods must be used. One of our engineering graduates has carried out the remarkable development of a coal mine 150 miles from Hankow, which he has equipped with an electric power station, conveyors, etc., in the most up-to-date style.

I cannot conclude this address without paying a sincere and a well-deserved tribute to Chinese engineers and artisans. For 25 years my energies have been devoted to training professional engineers, to advocating the creation of technical and trade schools in China, and to studying applied science problems that will have a profound effect not only upon one-quarter of the inhabitants of the earth living in China, but upon the rest of humanity; for all nations are being integrated by rapid communication into one great family.

Those of us engaged in this work in Hongkong have had very little help from those who might reasonably have been expected to encourage us. Chinese Universities and officials should co-operate with us. We have made many efforts to obtain appointments for our engineering graduates in the service of the local Government

with but little success. The emoluments paid and prospects offered to the few accepted have been less, unfortunately, than those granted to Chinese teachers and doctors trained in Hongkong.

We have been spared in the University the dragons of floods and corruption that obstruct engineering work in China, but we have had to fight the dragons of penury, prejudice and ignorance. With a very limited staff and equipment we have graduated since 1916 some 234 professional engineers. A number of them are in responsible positions. Of our graduates about 50 per cent are at work in China; the remainder in Hongkong, Malaya, Siam and the East Indies.

Most of the European critics know very little about China proper, and are usually entirely ignorant, not only of applied science, but of any science at all. Let me quote a great man under whose guidance I worked more than 30 years ago—Sir Oliver Lodge. He says that the majority of his own countrymen "live among phenomena of which they care nothing and know less. They see bodies fall to the earth, they hear sounds, they kindle fires, they see the heavens roll above them, but of the causes and inner workings of the whole they are ignorant, and with their ignorance they are content." Chinese engineers who are helping to mould the future of their nation, and who are obtaining very little assistance or material reward for their work, deserve encouragement in their difficult task.

A True Story

Let me tell you a true story that carries its own moral. One of my most brilliant Chinese students, after gaining a first class honors degree, left us to work on a railway. Ten years later I met him; he no longer practised engineering; he was a Government official connected with finance. When asked why he had abandoned his profession, he answered with a smile: "My salary was inadequate"—so he got a job with his hand nearer the till.

In our profession, as in the engineering foundries, there are "wasters." They soon break down when tested; they then choose some other easier method of earning a livelihood. The heroes in the engineering profession seldom made fortunes; but they were men of high character, which enabled them to struggle with a care-free conscience in the search for Truth. You cannot imagine men like James Watt, who first harnessed steam, Faraday, who gave us the dynamo, or Lodge, who forged the last link in wireless, guilty of a mean intrigue, an act of selfish scheming, or the deceit which is often revealed, and more often hidden, in the lives of those who become prominent by reason of a clever cunning, a plausible manner, and a superficial knowledge.

Traditions of the Profession

There are at work in many parts of the world men who maintain the highest traditions of the engineering profession. Lord Nuffield, a successful commercial engineer, has by his industry and splendid benefactions set an example for local aspirants to fame. The railway to Canton and a splendid road in Kowloon remind us of a famous Royal Engineer, Sir Matthew Nathan. No foreigner in the Far East has been regarded with such respect as a Royal Engineer known to history as Chinese Gordon. Another named Kitchener transformed the Sudan and reconciled Boer and Briton in South Africa. The list of benefactors to civilized and to backward races in all parts of the world who have left permanent monuments of their endeavors by changing deserts and swamps into productive land could be indefinitely extended. Their useful work gave them a satisfaction that no transient pleasures can supply.

Engineers do not underestimate the value of money—as my Scotch friend says, "it is a handy thing to have in the house." But the lives of the most famous engineers show that with them money was of secondary importance; the quality of their work came first.

In spite of the frailty and selfishness of human nature, and the inefficiency of human endeavor, engineering progress continues with ever increasing rapidity and beneficent results upon social conditions all over the world. Chinese engineers and artisans, handicapped by tradition, the poverty of their nation, and many other obstacles, are doing splendid work in China—work of which so few Chinese and foreigners are aware.

(Continued on page 65)

China Buys Another German Dredger

Messrs. Schichau, Elbing, Build World's Largest Giant Drag Suction Dredgers for Whangpoo Conservancy Board

It has often been clearly pointed out that the existence of Shanghai as a port is entirely dependent upon the constant dredging of the approaches to the Whangpoo River and of the river itself. Perhaps, however, with this truism accepted, its natural corollary, the importance of dredging equipment and operations, has not sufficiently been recognized.

The huge dredger *Chien She*, built in Germany for the Whangpoo Conservancy Board by Messrs. F. Schichau, Elbing, has been operating constantly for the past two years. It has just been announced that Messrs. Schichau have been awarded another contract by the Conservancy Board for the construction of another giant drag-suction type of dredger, which will cost some £231,700 and will be delivered at Shanghai within two years.

With both these dredgers in operation, the water depth at the port entrance will be increased by nine feet, which will allow vessels drawing up to 33 feet to enter the port at all stages above half-tide. This is indeed a prodigious task in the history of dredging operations. Some 40,000,000 tons of mud will have to be shifted from the entrance bar and dumped some two miles distant.

As designed at present, the new dredger will be the largest of its type in the world, and the most powerful. Its engines will have an output of 7,000 h.p. in comparison with the *Chien She*'s 5,400 h.p. engines. While the daily output of both vessels will be about the same, approximately 30,000 tons of mud for each dredger, the new dredger will incorporate several improvements, making operation more efficient and easier to effect. The new vessel will have a gross tonnage of 10,000 and a mudhold capacity of 4,000 tons deadweight. The dumping arrangements in the new ship will be of a vastly improved design.

The *Chien She* has been operating for the past two years. Her guarantee period thus elapsed, an analysis of the vessel and her work on the Yangtze Bar in this past two years has just been published by the Whangpoo Conservancy Board and is of major engineering interest. It is presented here in part as an important document in the history of world dredging operations.

The Dredging Problem

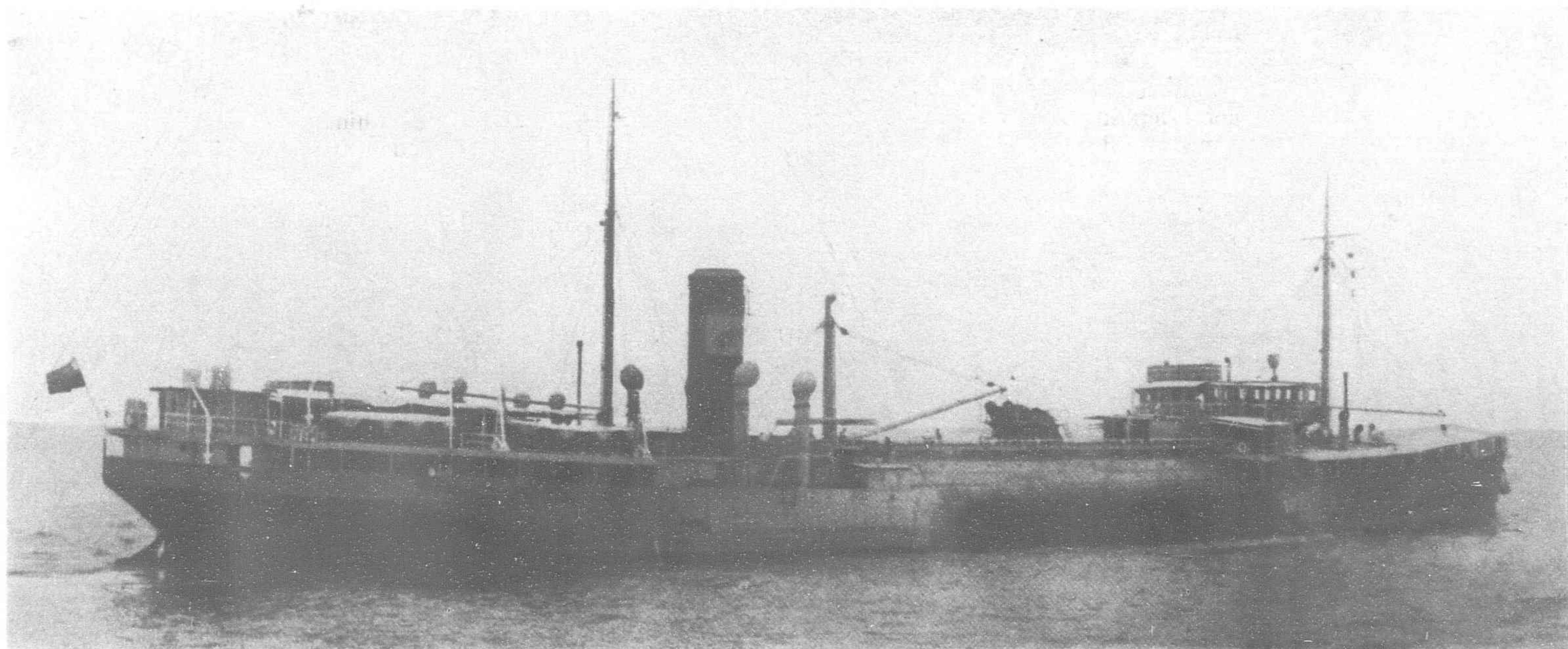
It was the object of the project to dredge a channel at least 600-ft. bottom width, with a maximum depth of 9-ft. below the crest level, over a length which might amount to 25 sea miles.

The minimum depth of water in the channel at extraordinary spring tide was about 17-ft. and the maximum tidal rise above L.L.W. about 16-ft., the mean water level having a rise above L.L.W. of about 8-ft. Tidal currents up to 6 knots, inclined as much as 45° to the axis of the cut, were known to occur, and the water was charged with fine silt up to as much as 2,000 parts by weight per million. The bottom was, as far as could be ascertained, a firmish clay-mud with a density of 1.8, a porosity of about 50 per cent, and a shearing resistance of about 300 lbs. per sq. ft. (1½ tonnes per sq. meter). Some patches of fine sand, density about 1.9, with a shearing resistance of about 600 lbs. per sq. ft. (three tonnes per sq. meter) were later discovered. The underwater slopes were very small, generally less than one per cent.

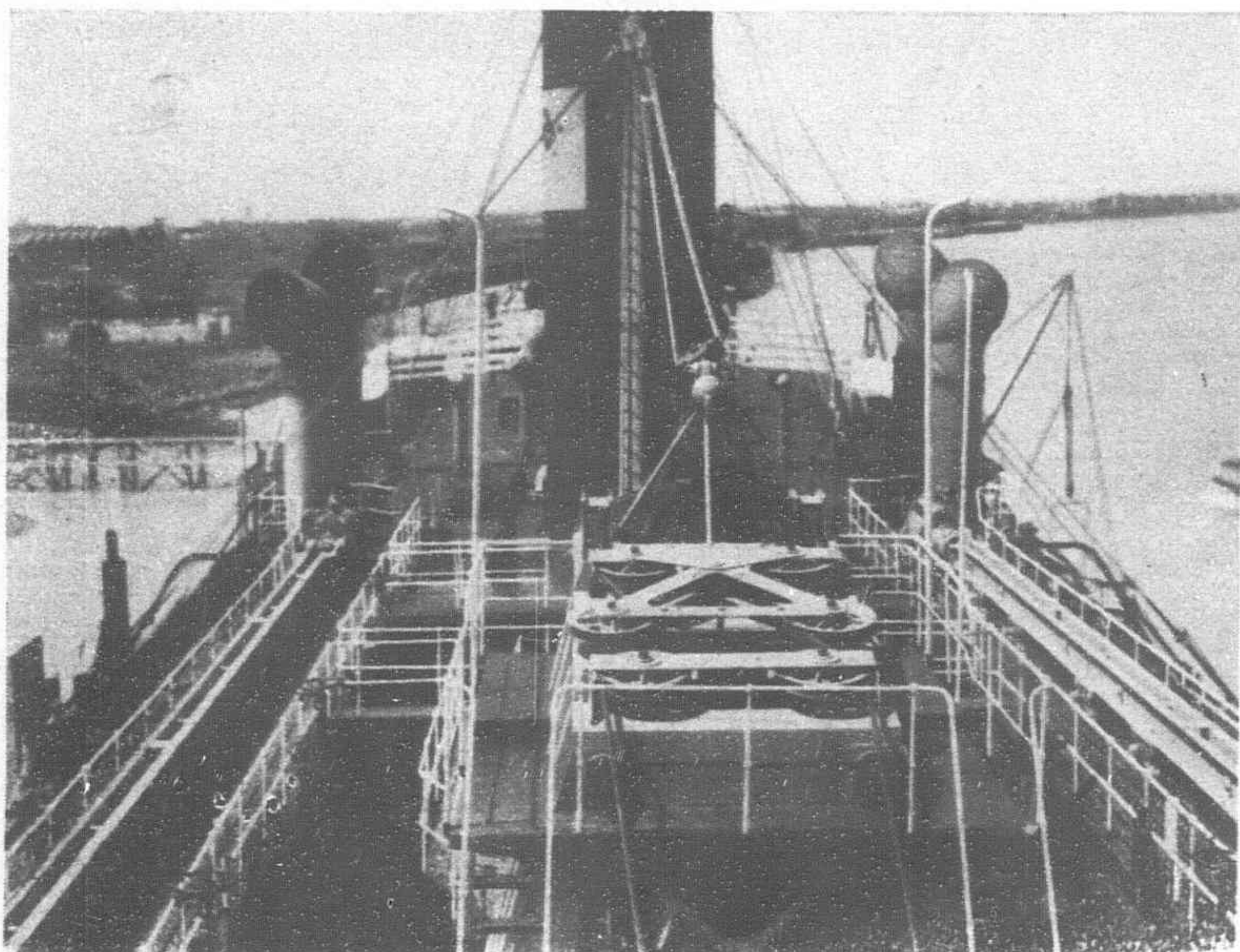
The route to be chosen was that of the talweg, valleyline, or line of greatest depth and allowing for, say, 50 per cent reaccrution it was considered that two drag dredgers each with an effective annual output of 5,000,000 cubic yards (say 4,000,000 cubic meters) would be adequate.

In view of the small slopes, fine material, strong currents, marine conditions and large silt charge, it was concluded that any attempt to dredge with moored dredgers would be futile so that the trailing type was the only one feasible. The Committee of Consulting Engineers, Shanghai Harbor Investigation, 1921 (Messrs. Black, de Vries, Hiroi, Hornell, Palmer, Perrier and von Heidenstam) had stated that there was reasonable hope of success.

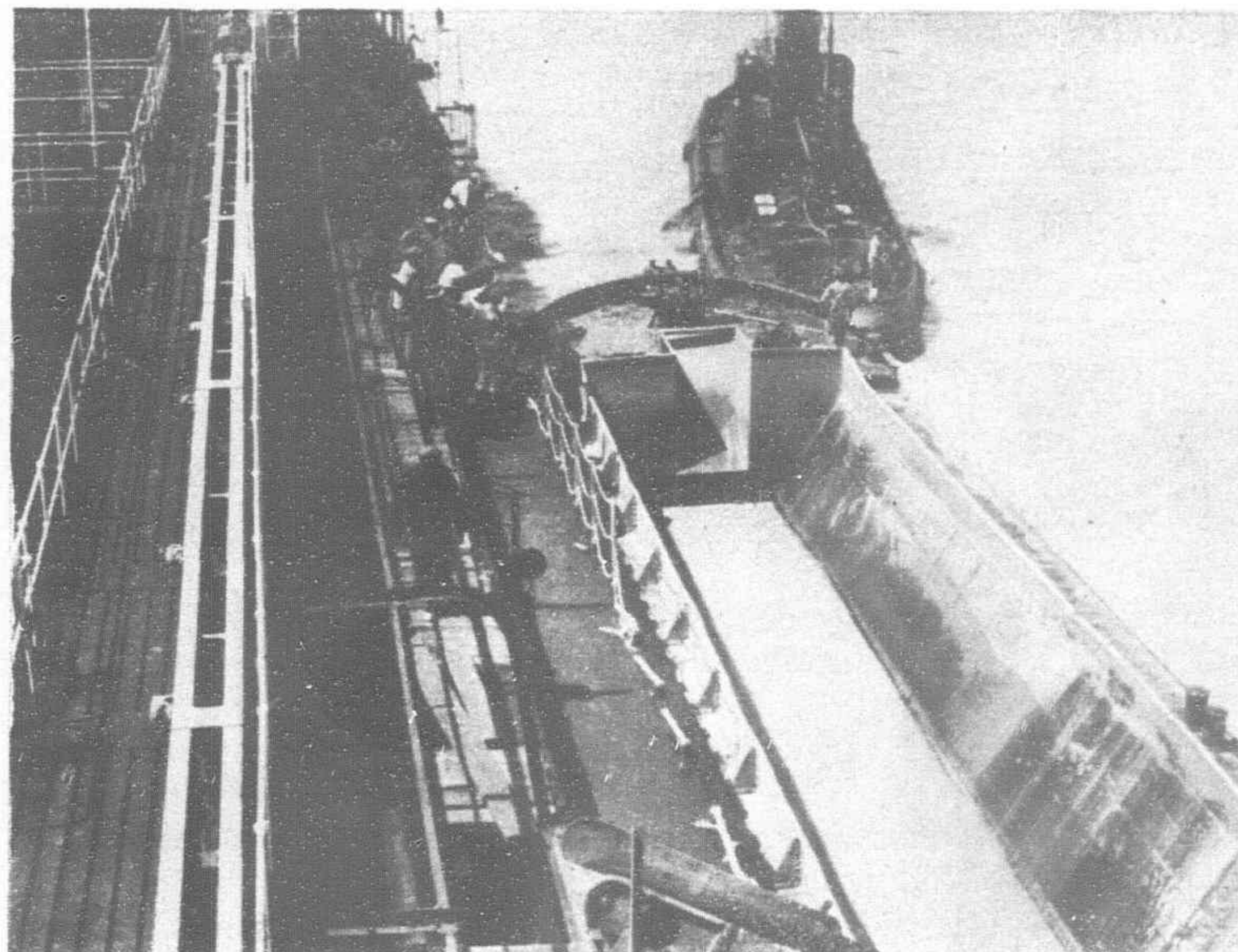
A deepish pool suitable for dumping exists within two sea miles of the crest of the bar. Night working was not contemplated, at any rate in the first instance, and weather conditions indicated that at least 10 per cent of time might be lost by fog and heavy seas. Allowing further for coaling, repairs and annual overhaul, it was assumed that the working hours per annum might not exceed 2,000, implying a rate of 2,500 cubic yards (say 2,000 cubic meters) dredged, transported and dumped per hour. The transportation and dumping were assumed to occupy half the time; considerations of length, beam and draft, limited the hopper load to about 4,000 tons of mixture. Allowing five minutes for approaching the cut and lowering and raising the suction pipe on completion, this implied a dredging rate of 100 cubic yards (77 cubic meters) per minute or 1.67 cubic yards (1.3 cubic meters) per second. Allowing a speed along the cut 2 knots (3.4-ft. per second or say 1.03 meters per second), the mouth of the drag head needed to



The dredger "Chien She" in action at Yangtze Bar



View of the upper works of the dredger "Chien She"



After the arrival of the dredger, bunker coal, carried in the mud hoppers on the voyage out, is being discharged

be more than 14 sq. ft. (say 1.25 sq. meters). As a certain amount of dilution water would be needed (apart from the high pressure water which enters by jets in the head) and also the head was to be at times oblique to the axis of the cut (on account of the oblique tidal currents), it was decided to specify a width of 9-ft. and a depth of 2-ft., i.e., an area of 18 sq. ft. The study of the mud had shown it to be reducible to a very fluid state with the addition of 50 per cent of water, giving a density of $(0.6 \times 1.8) + (0.3 \times 1.0) = 1.53$. Even with 25 per cent of added water—density $(0.80 \times 1.8) + (0.20 \times 1.0) = 1.64$ —the mixture was quite mobile. Since the added water can enter faster than the mud, the areas provided appeared, and actually later proved, to be adequate.

With such a thick mixture, a fraction of the vacuum is used in supporting the load in the pipe, leaving a smaller amount to overcome friction. Thus if the eye of the pump is at water level (actually in the light draught position it is about 2-ft. below water level), the lifting head required to raise material with a density of 1.6 is $(1.6 - 1) 45 = 27$ -ft. or nearly 25-in. of mercury. When the draghead is only 30-ft. below water level, the lifting head is diminished to 18-ft. or 16½-in. of mercury (If the eye of the pump is 10-ft. below water level, and the draghead 30-ft. below water level only 2-ft. of lifting head is required). With such a limited margin every effort must be made to reduce the resistance on the suction side. The builders were therefore required to streamline the interior of the head, to make the high pressure water nozzles flush and directed in the direction of flow, a single suction pipe 1.1 m. diameter was insisted on, and the direct arrangement of the pipe from the head to the eye of a single central low-placed

pump was considered essential. In order to avoid variation in the cutting angle and the deflection angle at the back of the head, the pressure water pipe was made into a linkwork which maintains the head in a constant "attitude." A very liberal supply of high pressure water (11 tons per min. at 75 lbs. per sq. in. pressure or 27 tons per minute at 14 lbs. per sq. inch) was allowed.

As a result of all these precautions it proved easy to obtain a mud mixture with a density of well over 1.6 from a depth of about 30-ft., and whole hopper loads with over 1.5 were frequently obtained. Apart from the design, this must be mainly attributed to the smoothness of the mud and the stability of the mixture once it has been churned up. Later, with fine sand about 20 per cent of sand by volume (mixture density 1.18) was about the best result obtained, as against 66-80 per cent with good mud.

The velocities in the suction pipe vary from about 5-ft. per second (say 1½ meters) for thick mud mixture to perhaps twice that value for sandy mixtures.

Still another important aspect of the design is the provision of ample thrust for cutting the bottom with the drag head. Assuming the depth of the cut is 2-ft. and effective width 10-ft. and that the mud ruptures along a plane inclined 1 in 3, the rupture area is 60 sq. ft. which at 300 lbs. per sq. ft. of shearing resistance = 18,000 lbs. or say eight tons. If this force is exerted at a speed of 3.4-ft. per second, the horse-power required is $\frac{18,000 \times 3.4}{550} = 111$ h.p.

As it often happens that the adverse current is up to six knots (making a total relative water speed of 8 knots) the propelling capacity needs to be ample to cope with the combined ship and

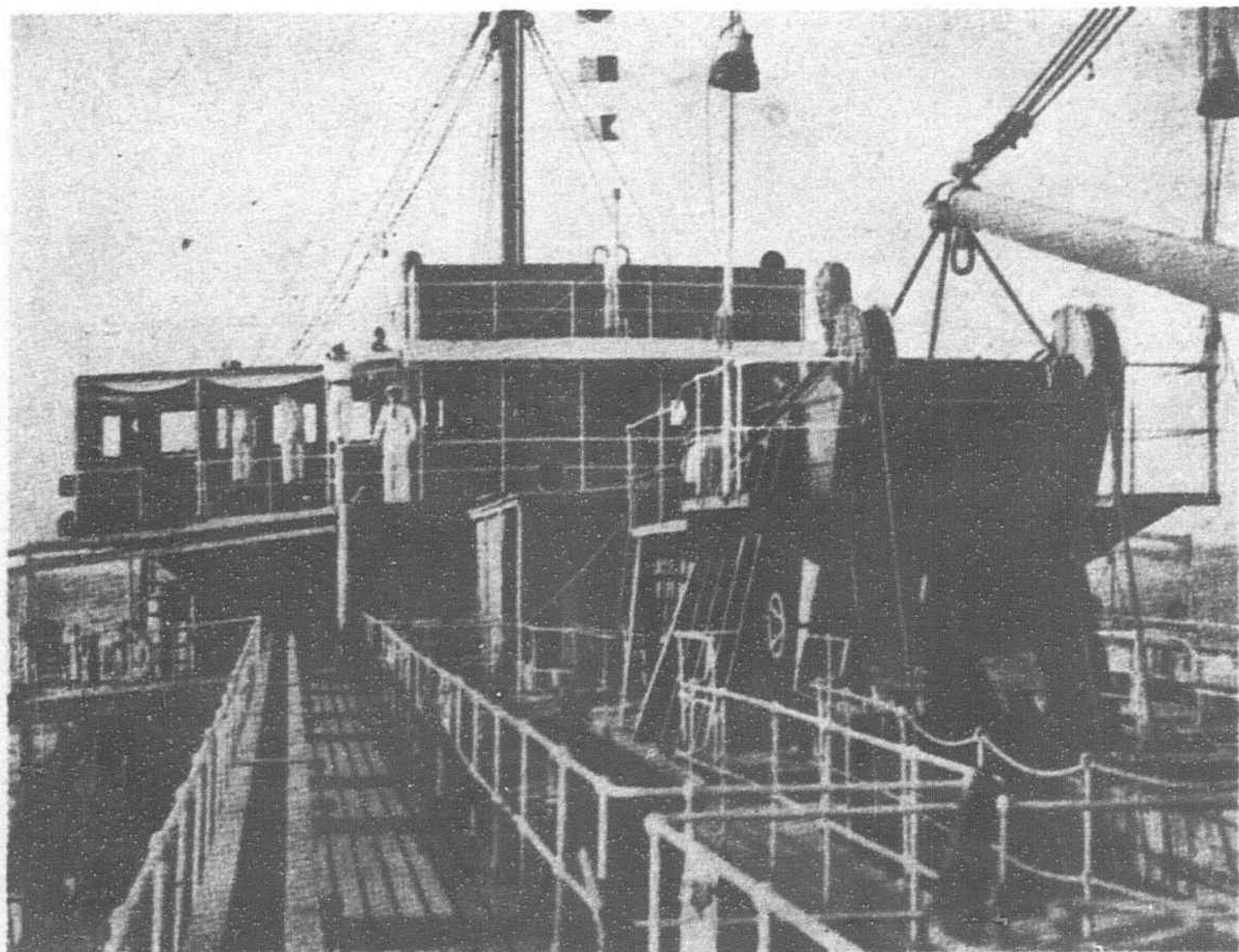


Fig. 34.—General view of dredger looking forward

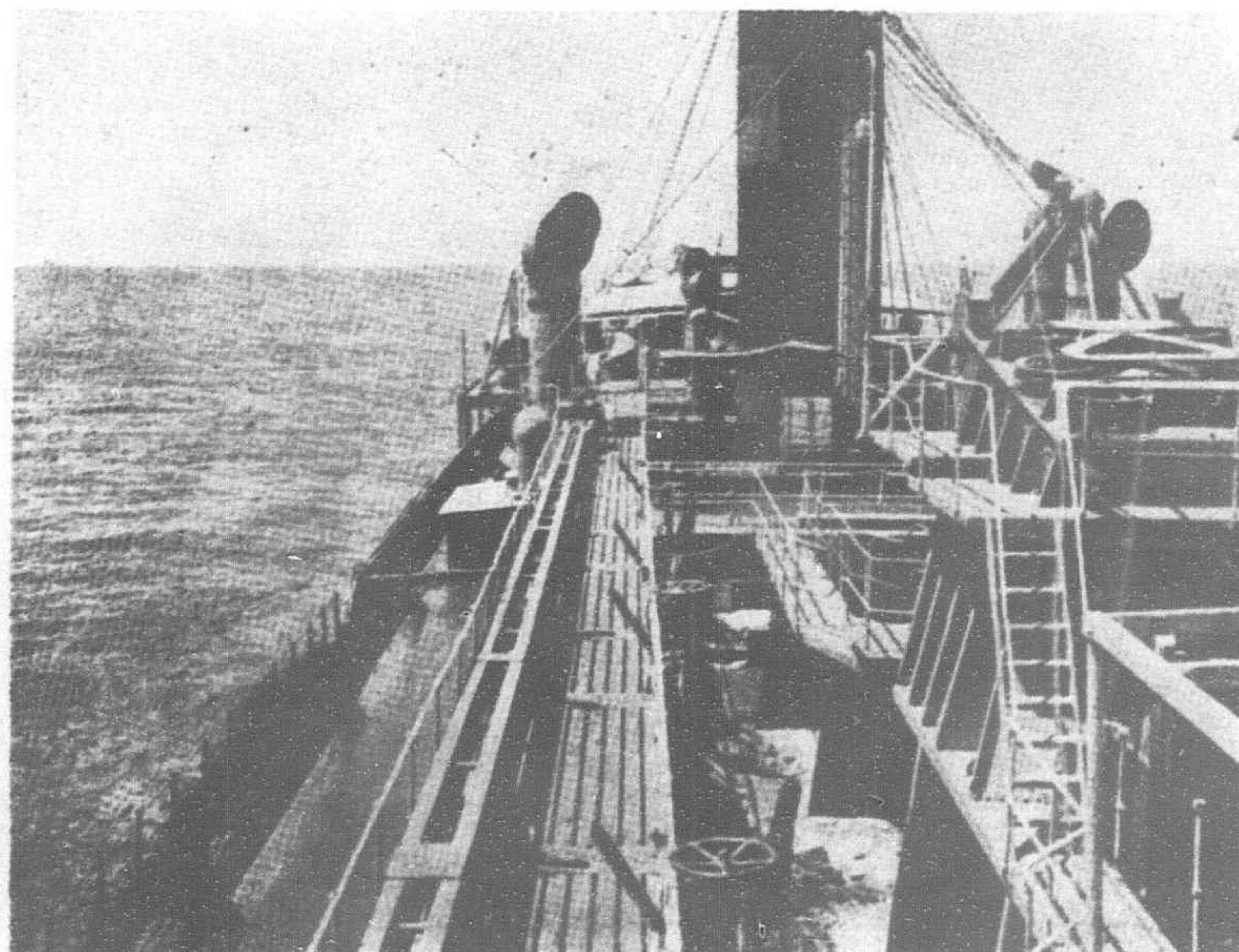


Fig. 35.—General view of dredger looking aft

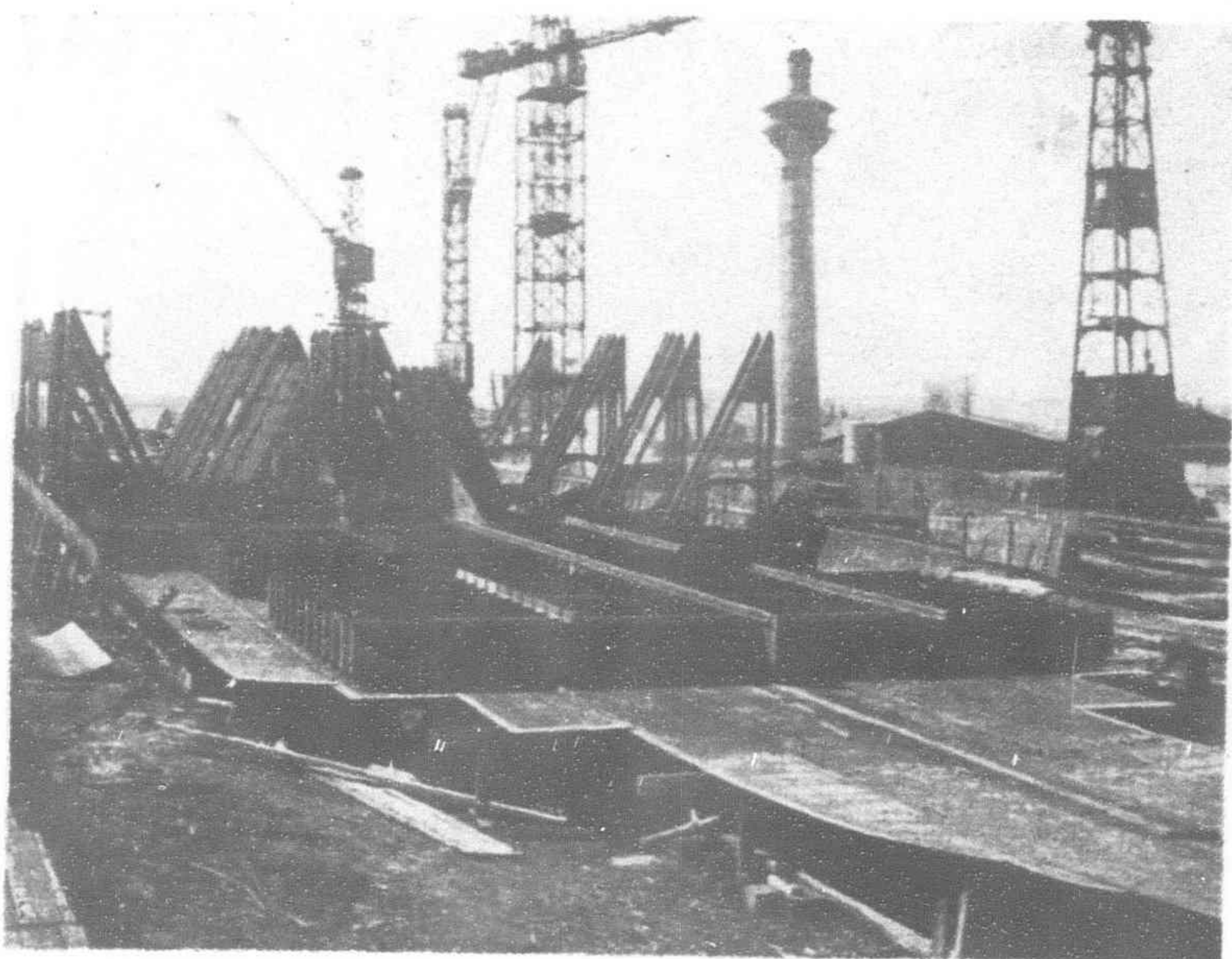


Fig. 24.—State of progress 21/4/34

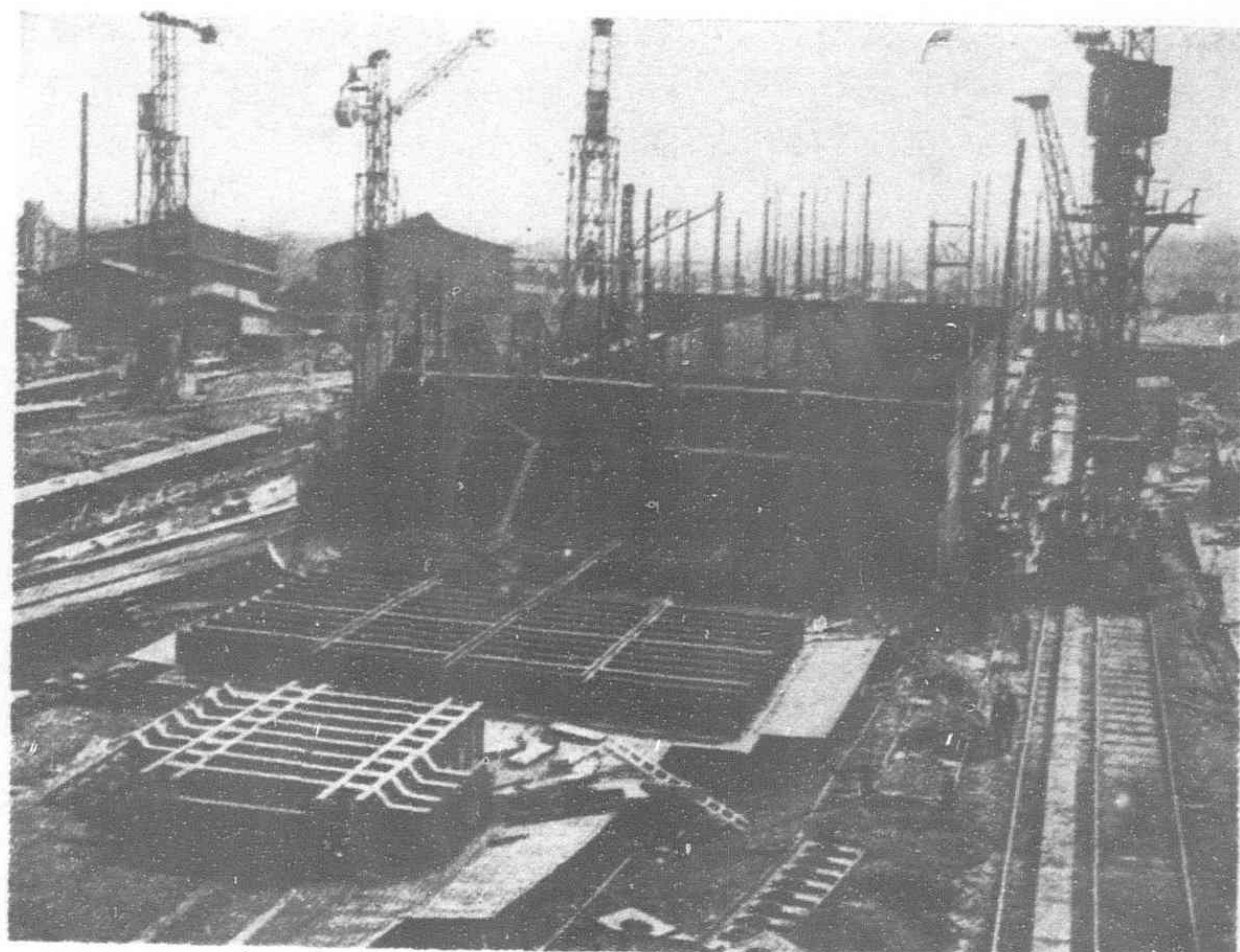


Fig. 25.—State of progress 7/5/34

drag head resistance. 3,000 h.p. at 132 r.p.m. is available from the two propelling engines. The propellers usually run at about 120 r.p.m. when dredging, so that the ejection speed is about 21.5-ft. per second. If the relative speed is 10-ft. per second (6 knots) the impelled speed is 11.5-ft. per second, giving a thrust of about 20 tons, leaving, say 12 tons to overcome the ship's resistance, which is ample at that speed.

The position of the suction pipe plays an important part in the design of the ship. In the original Frühling design and all the older models, the stern of the ship is split and the suction pipe trails below or behind the rudder. This allows much better arrangement of the machinery and hopper and easier handling of the drag head and avoids any danger of the head fouling the well, but it makes the vessel very difficult to steer, especially in cross currents, and, if there is any pitching, causes the head alternately to rise in the cut and to bump. The experience in the Argentine is stated to be decidedly in favor of the center well and this arrangement was adopted, with entirely satisfactory results. It has a further advantage that by means of a strong framework attached to the suction pipe ladder, the latter can be arranged to bear against the side of the well, thereby relieving the pipe trunnion of considerable strain.

A very sensitive universal control of the pipe hoisting winch in conjunction with vacuum gauge from the main pump enables the dredging to be carried on steadily and efficiently.

Density of Dredged Mixtures

In drag suction hopper dredging, it should obviously be the aim to produce the densest possible mixture which can be pumped.

Even if the power required during pumping is in excess of the optimum value for that process *per se* the decrease of the cruising and dumping period will generally neutralize any loss of energy due to this cause.

Practical experience with the dredger *Chien She* on the Yangtze Bar has since shown that, for certain conditions, the mud might be pumped with almost no added water at all.

The specific gravity of the *in situ* material is not of itself the sole criterion to be considered. The grain size is also not the decisive factor, although it is probable that fine grained materials tend to be smoother and therefore will pump more easily than coarse ones. It is obvious that if the proportion of water filled voids ("Porosity") is the same for materials with different sized grains of a given material, the density of mixture will be the same. In practice, great variations of the *in situ* density occur with little or no change in the mineral grain density, indicating clearly that the porosity varies largely. If the "pore-coefficient" (ratio of pore space to grain volume) is used the differences are still more remarkable. Thus the mud in the Koenigsberg ship canal at Pillau (E. Prussia), where the *Chien She* had builder's trials, had a density of only 1.25, while on the Yangtze the density was in places over 1.80. In both cases pumping was possible with about 50 per cent added volume of water, giving densities of 1.17 and 1.53 respectively. Taking the density of the mineral in each case as 2.6 the porosity of the German mud was 0.843 and its pore coefficient 5.4; the Chinese mud had values of 0.50 and 1.0 respectively. The pumped mixtures had values of 0.894 and 8.4 for the German mud and 0.66 and 2.00 for the Chinese mud. Such a difference is only explicable on the basis of a spicular or honeycomb structure

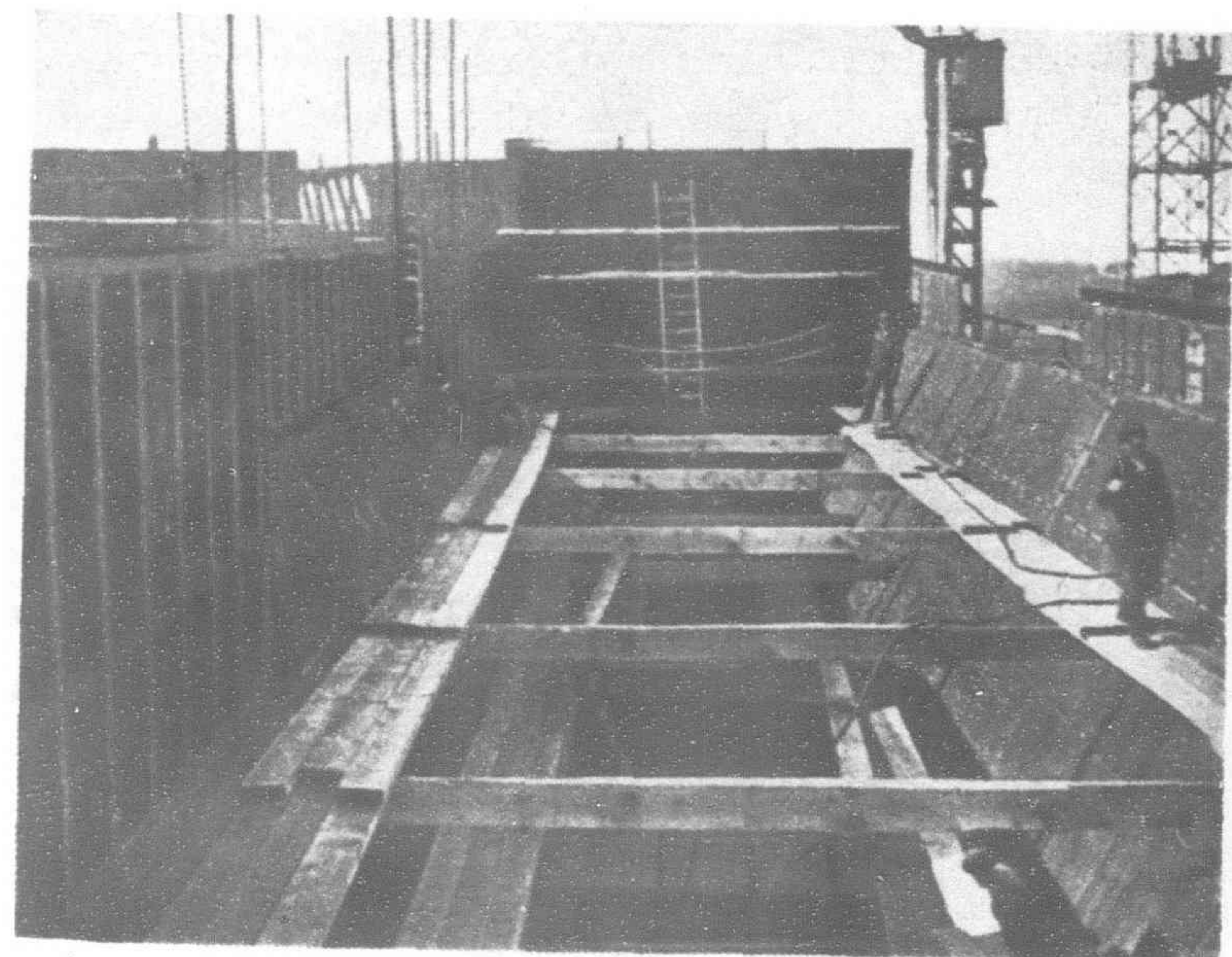


Fig. 26.—Plating of starboard hopper 7/6/34

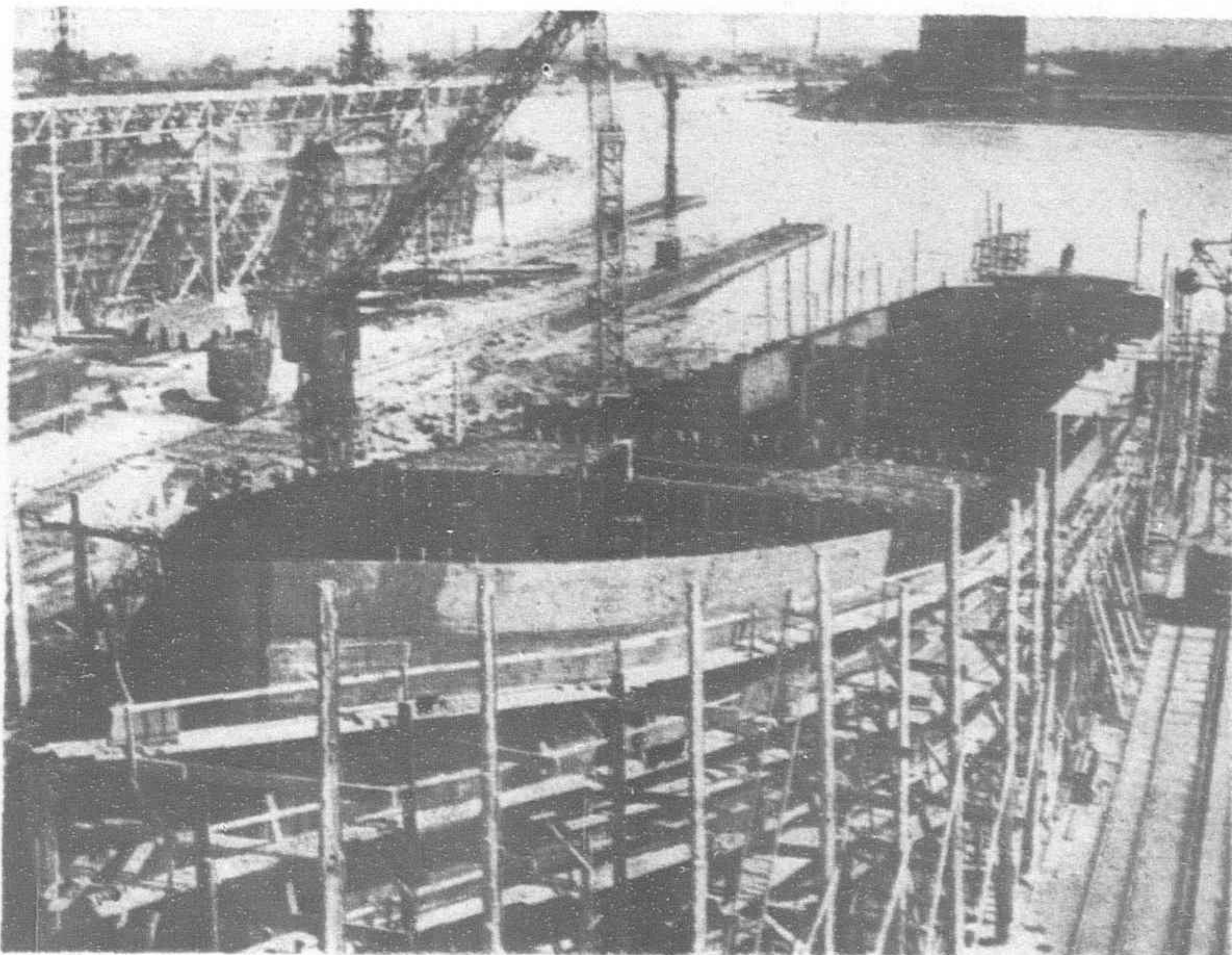
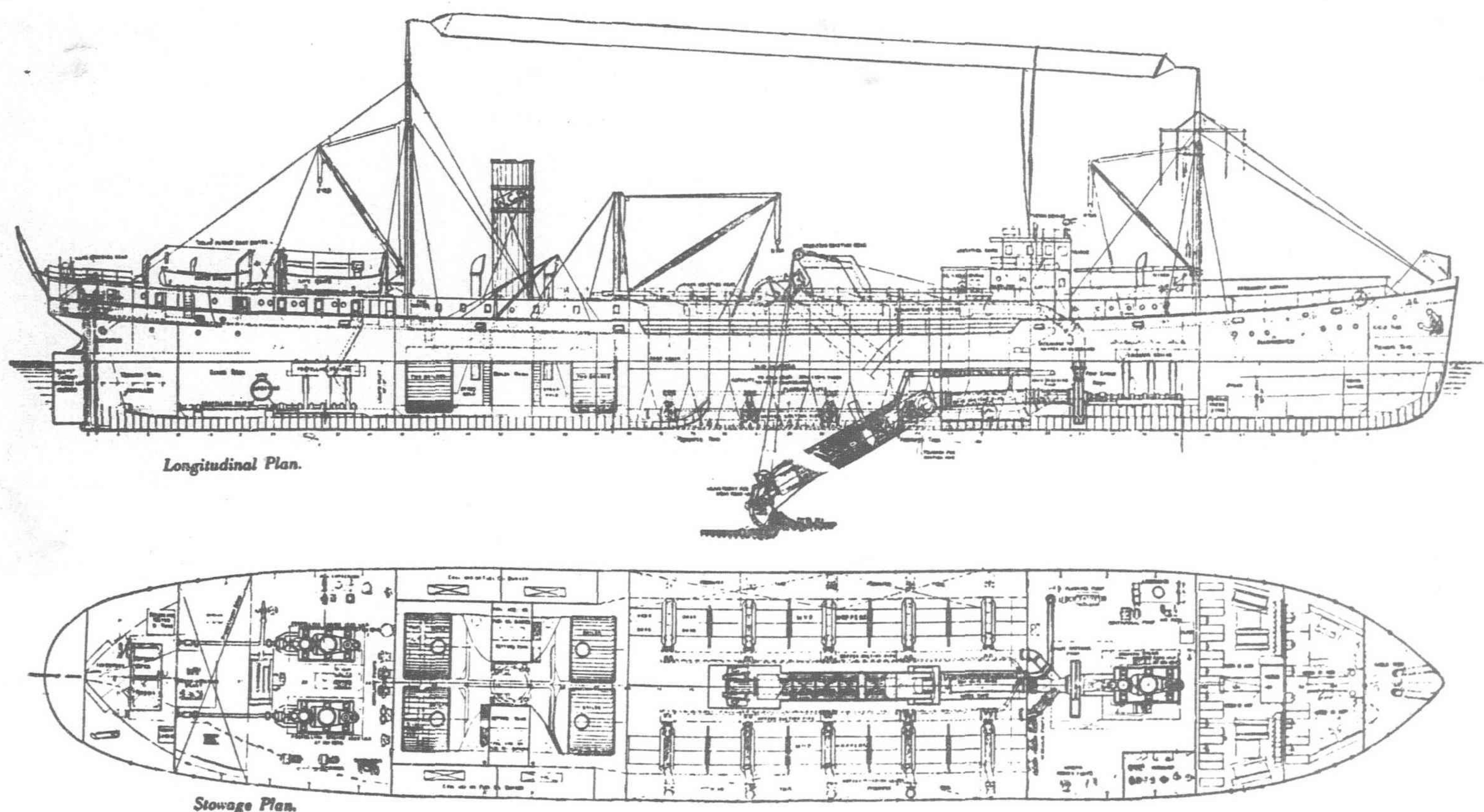


Fig. 27.—General view of the dredger under construction 22/6/34



Twin-screw drag suction hopper dredger with central well. Dimensions 373 feet by 60 feet. Constructed for the Whangpoo Conservancy Board by Messrs. F. Schichau of Elbing, Germany

in the German material which could remain firm and yet contain a large amount of interior space. Packed dry snow shows a similar anomalously low density due to its spicular structure. The Chinese mud, on the other hand, consists of compact or flaky particles which fit well together and only need slight separation to make them free.

Dredging Sand

There appears to be considerable doubt as to how far the Frühling principle can be applied to the dredging of sand. Experience both in the Yangtze and elsewhere clearly shows that with the ordinary mud head the efficiency falls off greatly when dredging sand. This may be attributed to the following causes:—

- (a) Shallower penetration of the cutting edge into the bed on account of increased resistance, allowing much more dilution water to enter the upper part of the opening.
- (b) Rapid settlement of the sand in the mixture causing the average density of the mixture to be lower than required by minimum dilution.

From experience with the "Leviathan" and other sand pumps, it is clear that in certain circumstances mixtures containing as much as 45 per cent by bulk volume of sand (density of mixture say 1.4) may be pumpable and the practical problem is how such a density may be produced and maintained. Many designs have been studied, including disc plough, jet intake of suction water, relief valves for suction water, spade pointed and parrot beaked cutting edges, shoe shaped drags with cutting grills, oscillating heads, etc., but in many cases these are speculative designs. Some builders hold that the mud form is also the most suitable type for sand dredging, especially if a smaller entrance area is provided. Experience in the Yangtze appears to show that reduction of the entrance area by plates which divert the dilution water down on to the entering sand helps. Since the head cannot be buried in the sand as it may be in the mud, because of the extra dilution water wanted and the increased resistance, this appears a logical method. Strengthening the pipe and adding to the propeller thrust is also indicated.

Certain mechanical conditions apply to the cutting of sand which reduce the efficiency of a head designed for mud. The greater resistance of the sand to cutting causes the depth of the cut to be less, exposing the upper part of the opening to the relatively free inflow of the water. This cutting down of the water area will not increase the quantity dredged, which depends wholly on the depth of the cut, but it will increase the density of the mixture, so prolonging the dredged time required to fill the hopper and reducing the proportion of dumping time.

The voyage to Shanghai of the dredger *Chien She* in February, 1935, was conducted under the most economical steaming conditions to obviate re-bunkering was accomplished in 64 days and after completing a very extensive series of dredging output trials, which were successfully carried out with an ample margin, she was handed over to her owners on July 4, 1935.

The principal dimensions and other important particulars of the *Chien She* are given in Table I as follows:—

TABLE I.—PRINCIPAL CHARACTERISTICS OF THE DREDGER "CHIEN SHE"

Particulars	English	Metric
Length overall	373'-0"	113.690 m.
Length B.P.	360'-0"	109.726 "
Breadth, moulded	60'-0"	18.288 "
Depth, moulded	26'-0"	8.077 "
Gross Tonnage	4,699 tons	4,774 tonnes
Net Tonnage	1,858 "	1,887 "
Load draught, normal ..	18'-0"	5.486 m.
Deadweight tons	4,500	4,572 tonnes
Hopper capacity, cubic yards, to top of coaming	4,200	3,210 cub. m.
Hopper capacity, cubic yards, to deck level	3,700	2,828 "
Maximum dredging depth ..	45'-0"	13.715 m.
Dredging output of solid <i>in situ</i> mud from the Yangtze Bar of density 1.8 metric tons per cubic metre, dredged, transported in hoppers, deposited by hopper doors two sea miles distant from dredging base in a total of 10 working hours		25,000 cub.yds. 19,110 cub. m.

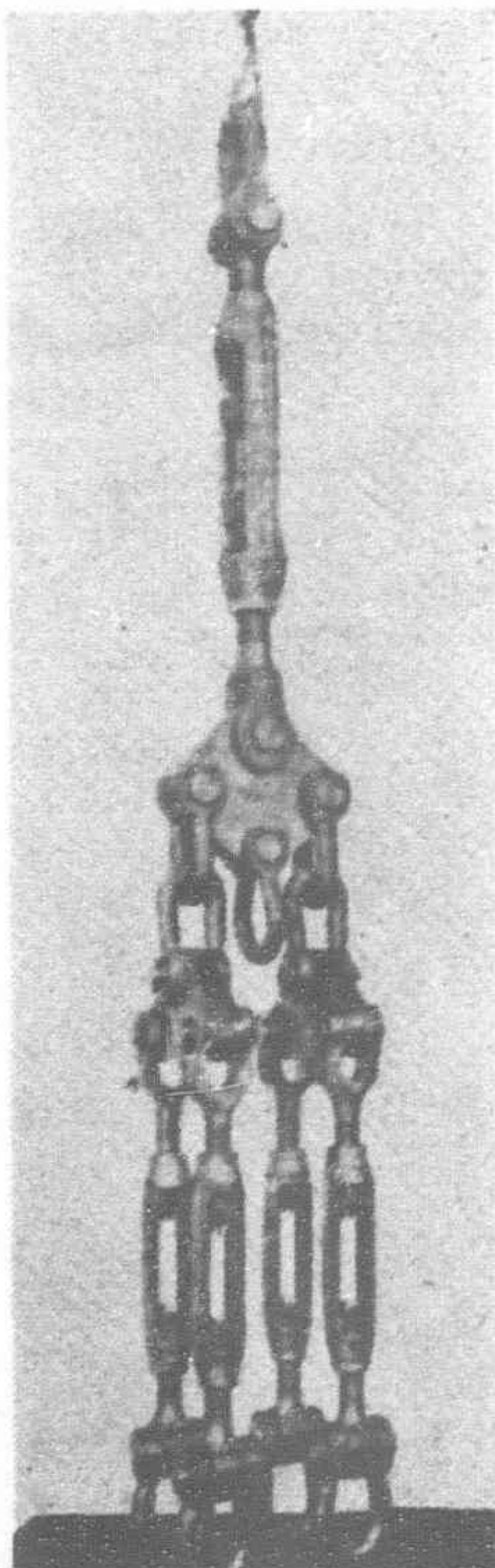


Fig. 5.—Turnbuckles and shackles for hopper door gear

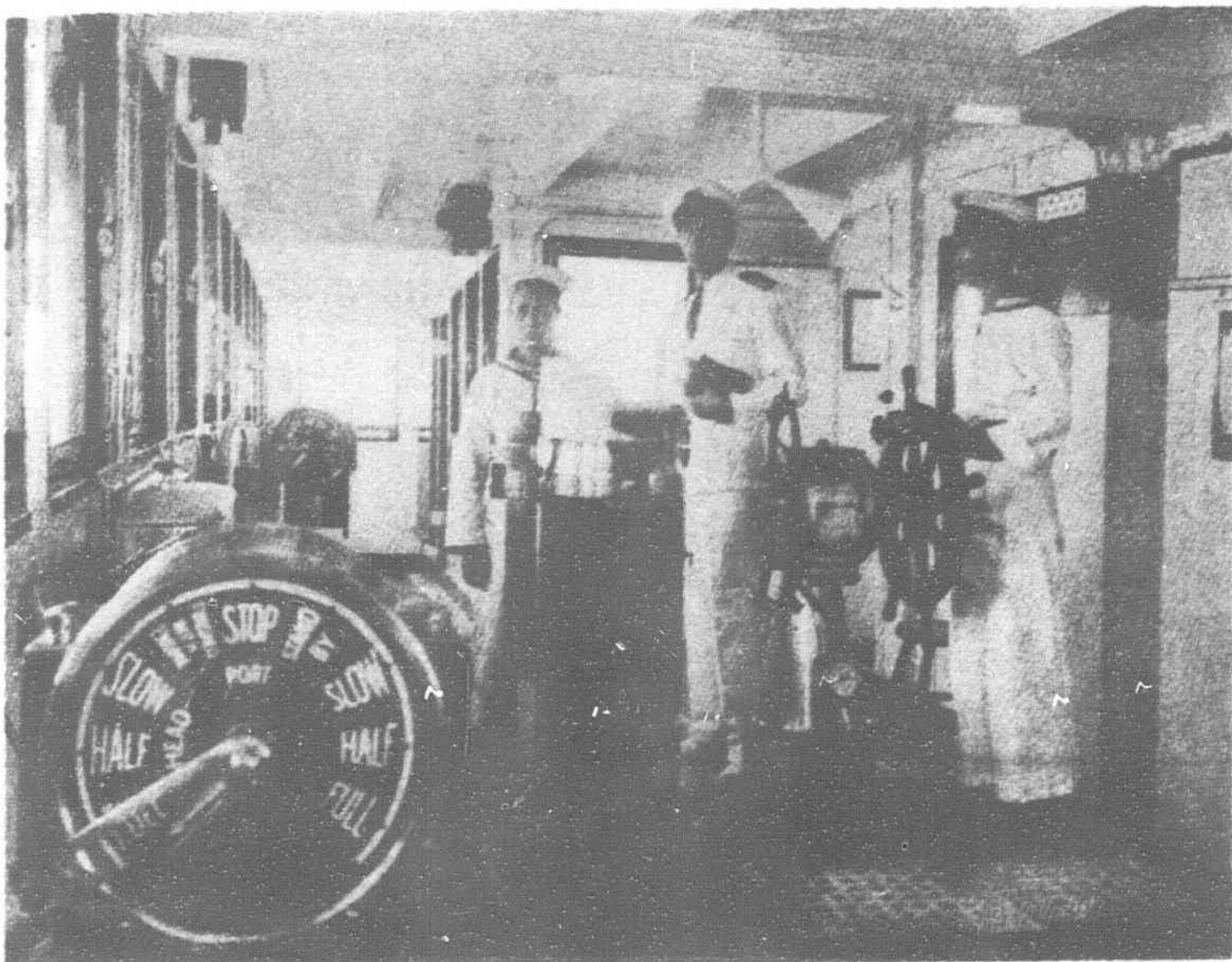


Fig. 1.—View of the navigating bridge

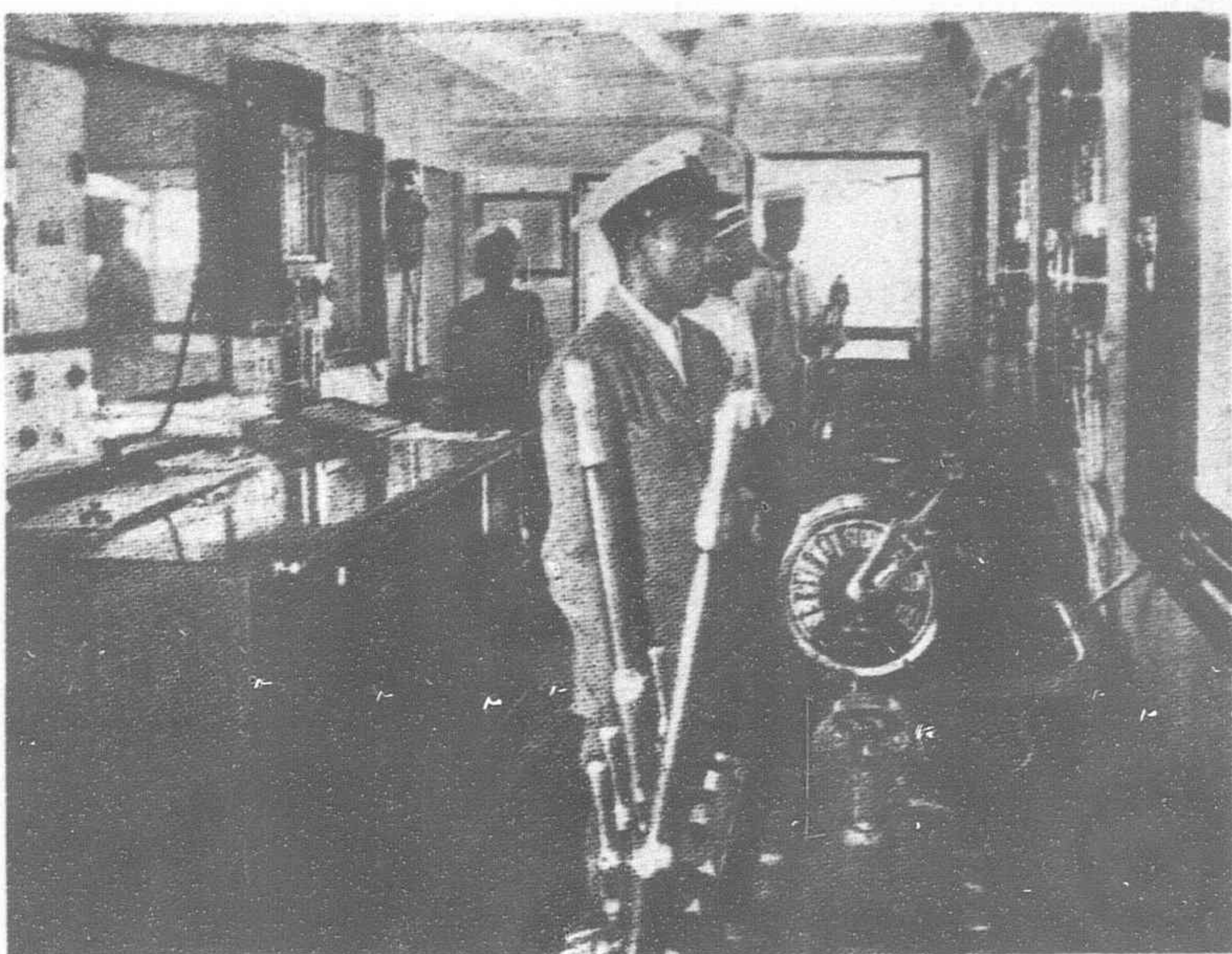


Fig. 2.—View of the operating control room

The vessel has been built in accordance with the requirements of Lloyd's Register of Shipping under Special Survey, the classifications $\times$ 100 A.I. Hopper Dredger having been assigned by that authority. The regulations of the Board of Trade have also been fully complied with.

General Arrangement

The photograph of the Dredger *Chien She* reproduced here, illustrates the vessel in service condition which to all outward appearance resembles that of a modern cargo steamer rather than a typical drag suction dredger.

The vessel has a raked stem of rounded plate form, and elliptical stern, a single funnel and two tall masts. The rudder is of the double plate type of stream-lined design and electrically welded construction as shown in Fig. 32; the steel castings having been supplied by the Builders Steel Works at Elbing, who also manufactured the stern frame and shaft brackets. The bull plating is bossed in way of the two lines of shafting and extends aft to the propellers.

Watertight sub-division is effected by six transverse bulkheads all of which extend to the level of the main deck, with the exception of the bulkheads at the fore and after ends of the hopper spaces, which are carried up to the upper deck. The vessel is further subdivided longitudinally by a center well amidships in which the suction pipe and dredging ladder are situated. Forward of the well is an additional watertight compartment through which the suction pipe passes to the dredging pump. This compartment is provided in case of damage to the well during dredging and also contains the hydraulically operated main sea suction, shut off valve.

On either side of the center well are arranged the spoil hoppers constructed with sloping sides which form large buoyancy spaces at the ships' side and center well sides respectively. The outer spaces have extra deep floors plated over and arranged as feed water tanks built with recesses in way of the sea suction valves to hoppers; the tank top plating and connection to ship and hopper sides being of welded construction. The spaces at the center well side are utilized for the installation of the main suction pipes and valves from the hoppers.

The peak tanks have a large capacity arranged for trimming

purposes. A summary of the capacities of the various fuel bunkers and tanks for fresh water and water ballast is given in Table II.

TABLE II.—TANK CAPACITIES

						Tons
Bunkers :—						
Cross bunkers	oil fuel,	6,740	cub. ft. Coal,	6,460	..	145
Starboard bunker	.. ..	12,050	.. ..	10,300	..	228
Port bunker	.. ..	12,350	.. ..	10,510	..	232
Settling tanks	.. ..	1,000	.. ..	.. ..	..	
Total coal capacity						605
Fresh Water :—						
Feed water tanks, port	.. ..	.. ..	.. ..	.. ..	..	127
Feed water tanks, starboard	.. ..	.. ..	.. ..	.. ..	..	127
Drinking water tanks	.. ..	.. ..	.. ..	.. ..	..	18
Total fresh water						272
Water Ballast :—						
After peak	.. ..	.. ..	.. ..	.. ..	..	154
Fore peak	.. ..	.. ..	.. ..	.. ..	..	156
Total water ballast						310

A large cargo hold is arranged forward for the storage of wire ropes, stores, and spare dredging equipment; aft of which are the pumping engine room, the hopper spaces, boiler room and propelling engine room respectively, whilst an insulated and refrigerated chamber having a storage space of 600 cubic feet in three compartments is situated in the 'tween deck aft.

The navigating bridge which extends from side to side of the vessel is enclosed in a steel casing lined with triple plywood and having large opening windows on all sides, the bridge deck is of teakwood and arranged with a double set of engine room telegraphs, a tele-motor steering control, a Kelvin steering compass, controls for a powerful searchlight fitted on the flying bridge, an electric navigational light and dredging signal indicator, and a Siemen's electric helm indicator. The arrangement of the bridge is seen from Fig. 1.

Aft of the bridge and communicating with it on the same deck is the dredging control room and chart house in which are installed the drag head operating wheel, pressure and

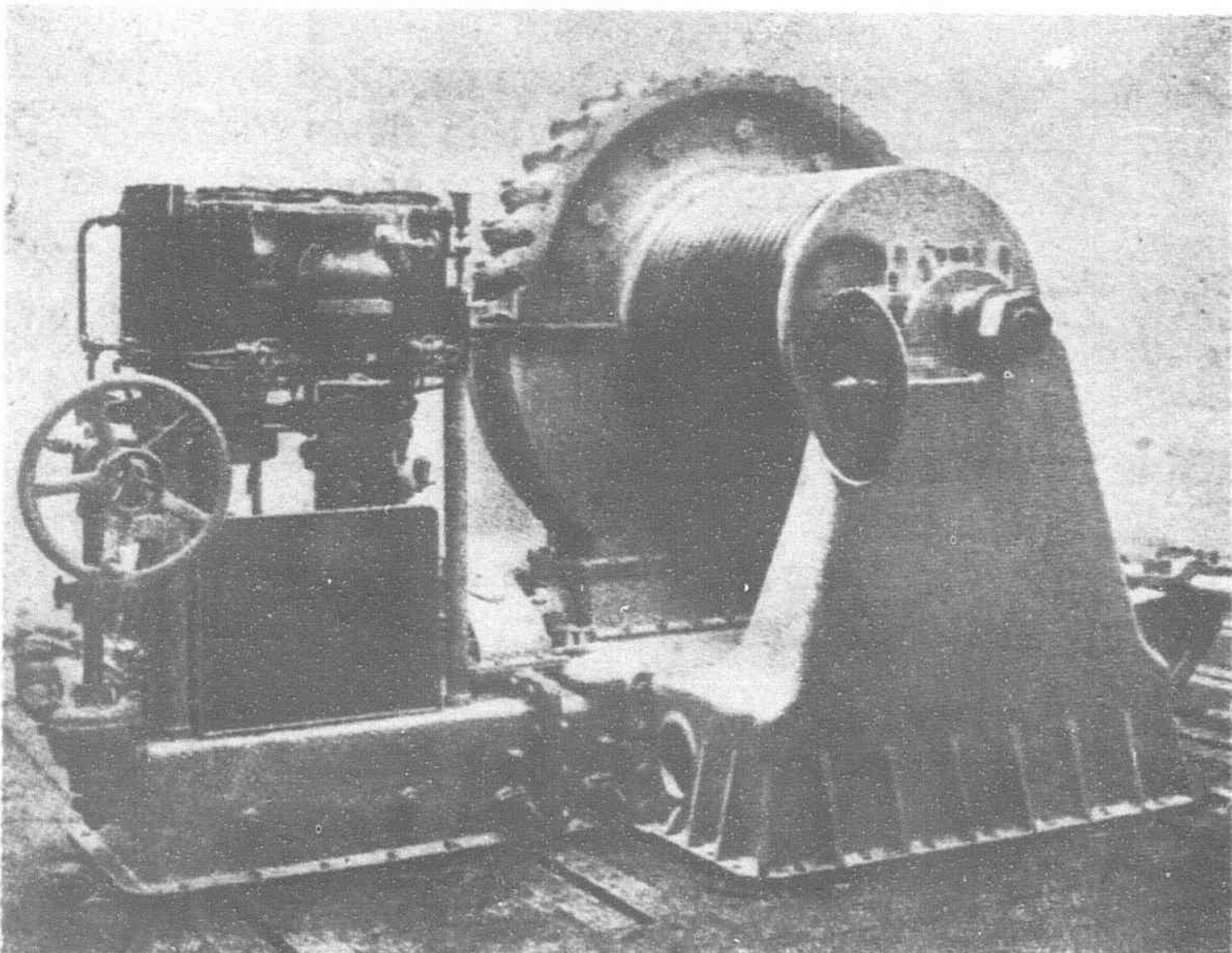


Fig. 3.—Ladder hoisting winch and engine

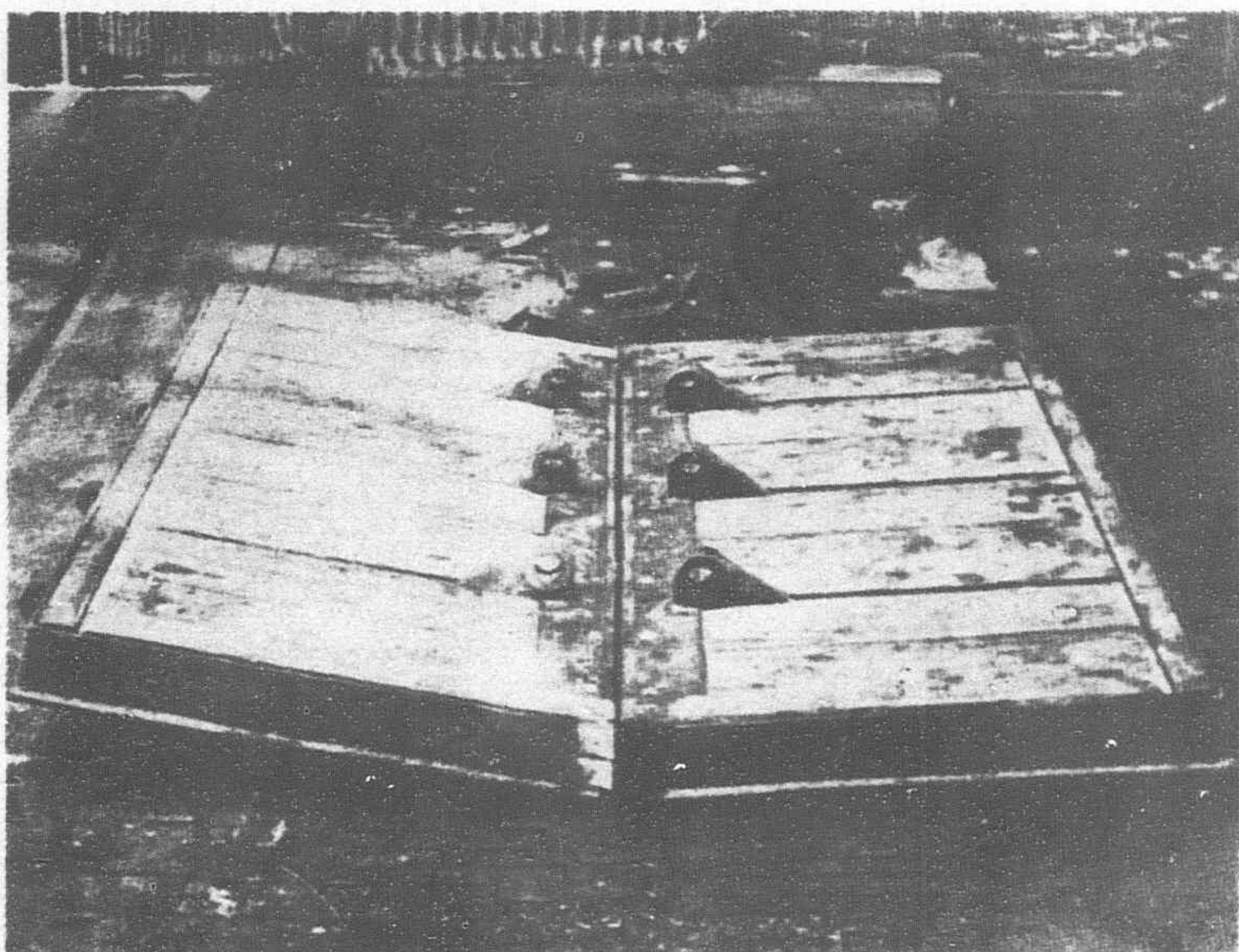


Fig. 4.—A pair of the hopper bottom doors

vacuum gauges, and the hydraulic control levers for manoeuvring all the suction and discharge valves in connection with the dredging equipment throughout the vessel. There is also installed, the pump room telegraph, an electric indicator for the sluice valves, the loud speaking telephones, a "Hughes" echo sounder, and a "Dobbie—McInnes" draught and displacement indicator. A view of the control room is shown in Fig. 2.

The whole interior of the navigating bridge and operating room is smooth finished in white enamel and presents a fine appearance with all the navigating and dredging equipment neatly and conveniently arranged.

Accommodation for Officers and Crew

The accommodation for the captain and dredging master, first officer, and chief engineer, is arranged below the bridge deck together with the wireless room and office. On the main deck aft six additional cabins are provided for the deck and engine room officers. The cabins are unusually large, well ventilated and comfortably fitted out for the tropical weather conditions under which the dredger has to work during the summer months. The steel decks forward and aft in way of all accommodation are sheathed with teakwood planking.

Cabins for the Chinese senior ratings, including: Dredging laodahs, wireless operator, engine room artificers and armed guards are arranged forward, at the port and starboard sides of the pump room casing. In the 'tween deck forward, light and airy accommodation is provided in four separate spaces for sailors, oilers, firemen, cooks and boys, fitted up with steel frame berths, lockers, and tables. The forecastle deck is of teakwood, and the 'tween decks in way of crews' space of oregon pine.

Well fitted bathrooms and toilet facilities are arranged in conjunction with the officers and senior ratings accommodation, whilst spacious toilet room, lavatories, and wash houses, are provided for the use of the crew.

On the poop deck aft is situated a suite of three staterooms, with bathroom and toilet adjoining for accommodation of the board's officials and dredging engineer during inspection visits to the dredger.

The full complement of the vessel is given as follows:—Captain and

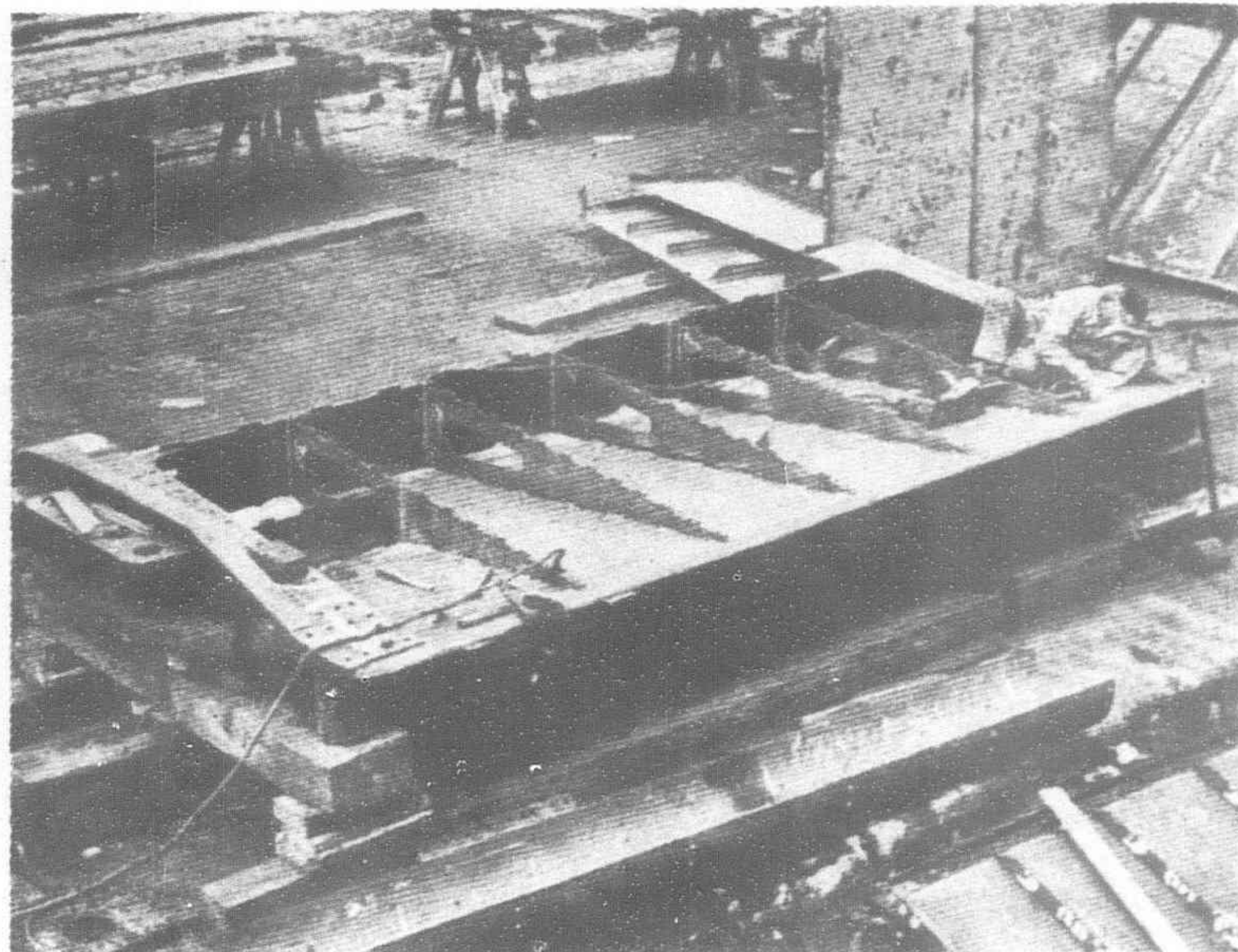


Fig. 32.—Rudder under construction

Dredging Master and Deck Officers 4; Chief Engineer, and Engineer Officers 5; Chinese Senior deck ratings and Medical Officer 15; Chinese Senior engine room ratings 13, Sailors 18, Oilers 7, Firemen 20; Steward 1, Cook 6, Boys 7 and other non-ratings 10, Totaling 106 persons.

Deck Machinery

All the deck machinery of the *Chien She* has been constructed at the builder's works at Elbing and is entirely of steam operated design.

The windlass is of the patent direct-grip, horizontal type, of specially massive construction for daily duty under service conditions and is mounted on the main deck forward. The cable holders are suitable for 2½-in. stud link chain cable, each having four snugs; warping ends are also fitted for mooring purposes. The equipment includes a pair of patent self holding and automatic releasing bow stoppers. Hand gear is also fitted to the windlass. The anchors are of the stockless type.

Two double cylinder horizontal steam winches are installed: one forward on top of pump room casing for serving the cargo hold five ton derrick, the other situated on top of the fidley casing working in connection with the eight ton derrick for handling the suction draghead.

The steam steering gear, which has also been constructed by the builders, is of the horizontal double cylinder, vertical type operating a cast steel rudder quadrant fitted direct to the rudder stock. The gear is controlled from the navigation position by tele-motor equipment.

There are also two steam warping winches and two coaling winches of the horizontal double cylinder, single drum type installed on the after main deck, one of the warping winches being arranged with a gypsy for handling the stern anchor.

A powerful double cylinder steam hoisting winch Fig. 3 is fitted on the hopper deck abaft the navigating bridge by means of which the outboard suction pipe and ladder is raised and lowered in the center well. The winch has double drums of large diameter with machine cut grooves for the steel wire cables, the ends of which are connected to buffer springs for taking up shocks which might occur during dredging, in order to prevent excessive

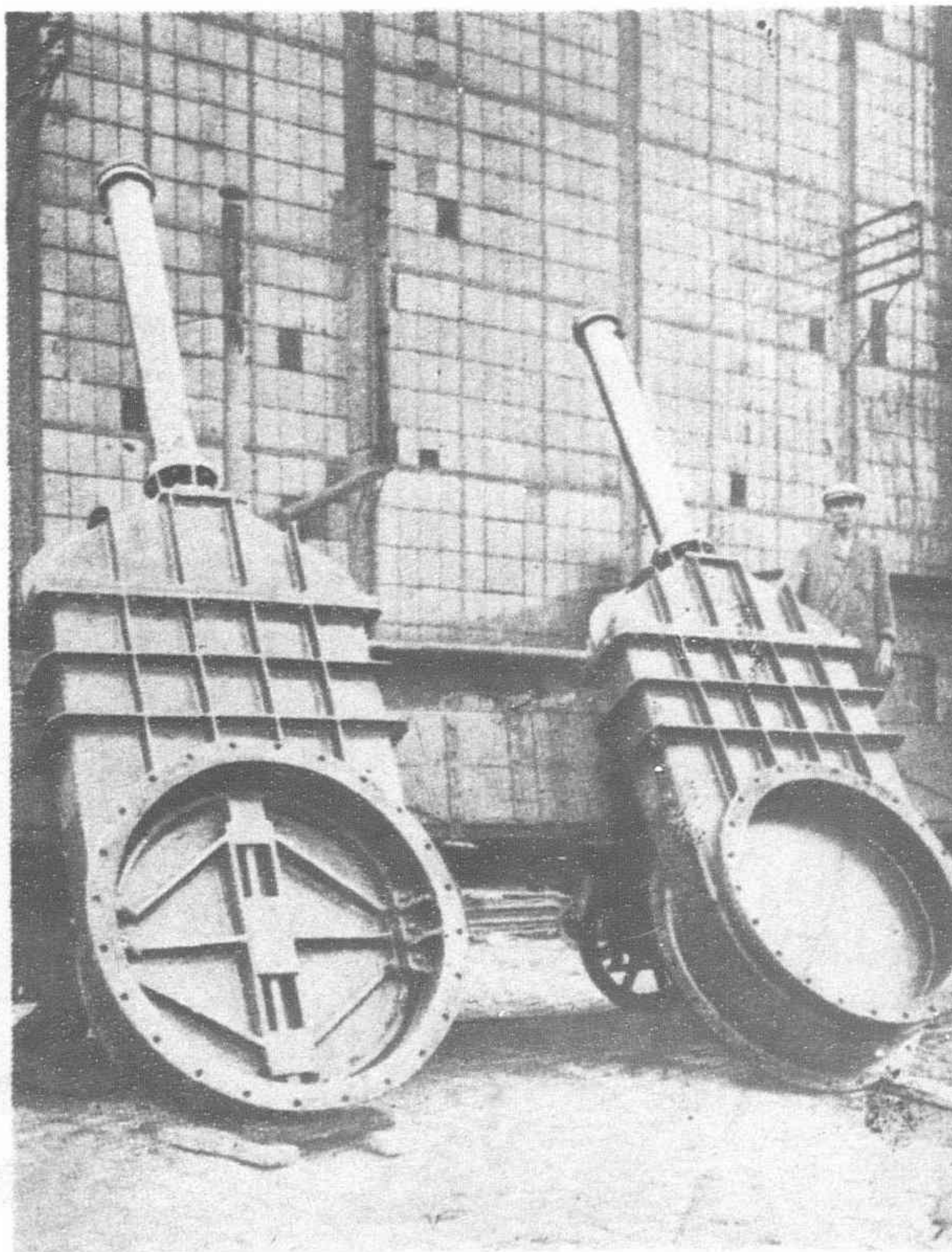


Fig. 33.—Welded hydraulic sluice valves

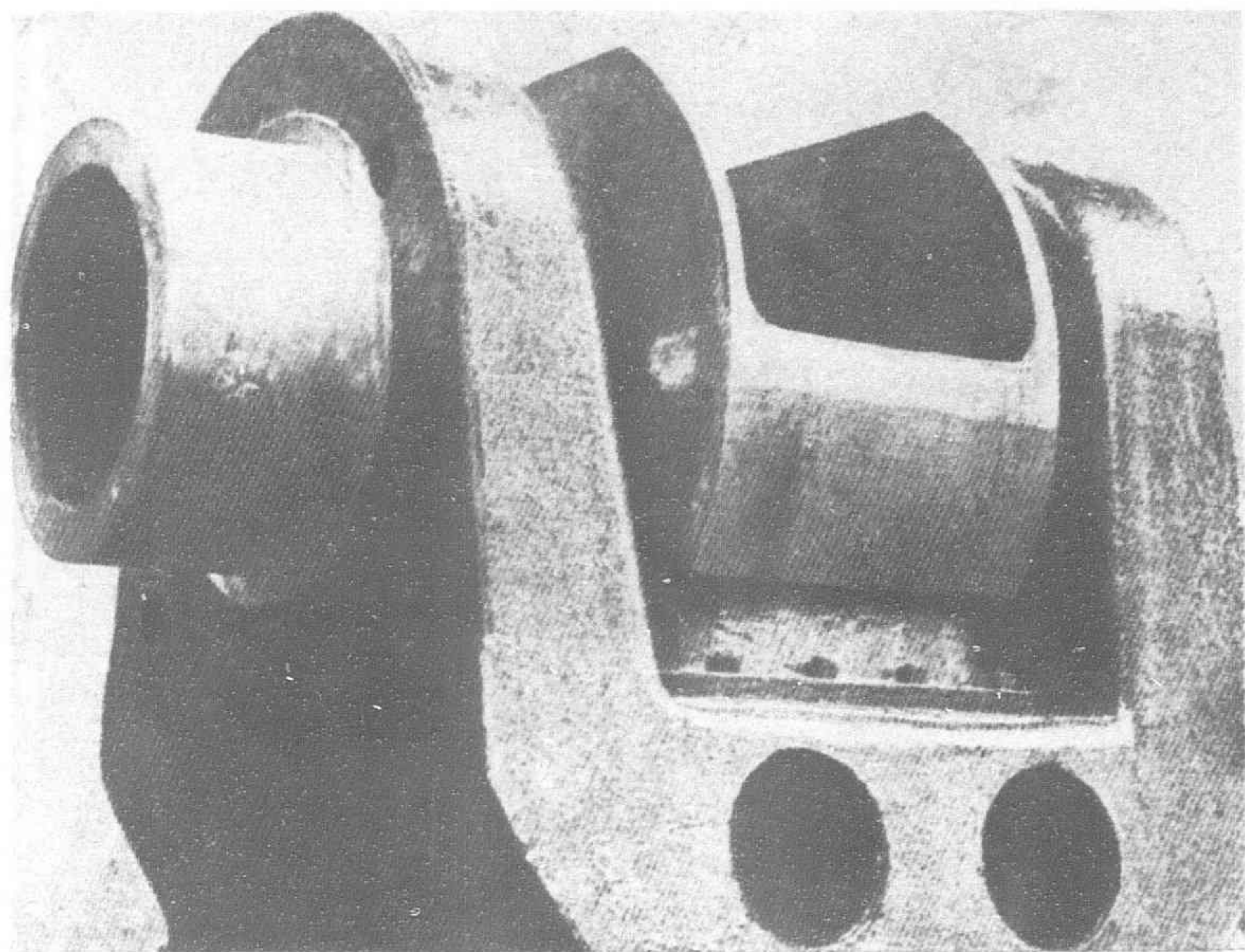


Fig. 6.—Sliding joint and trunnions of suction ladder

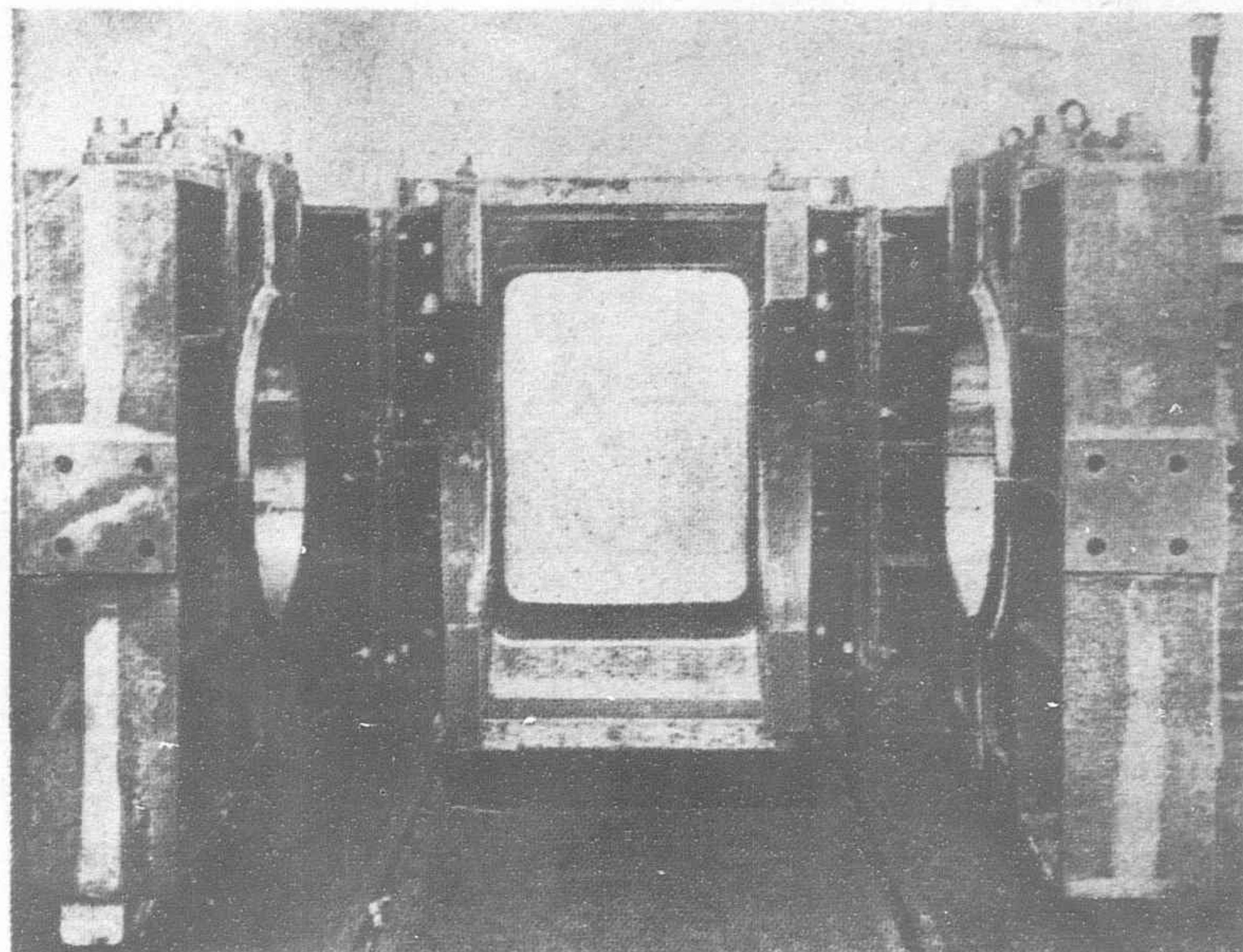


Fig. 7.—Side bearings and opening for suction sliding joint

stresses on the lifting cables. The hoisting drums are operated by a steel worm drive from the steam engine, gearing into a solid bronze machine cut worm secured to the drum shaft. The engine is controlled from the operating room on the bridge deck by means of a flexible shaft and gearing.

A brass dial graduated in feet, is arranged one at the draghead control column and the hoisting drums respectively, for indicating the depth of the draghead below water level.

Emergency Arrangements

Reference to the sub-division arrangements has already been made, and it may now be mentioned that door openings are arranged in the watertight bulkheads communicating with:—the outer and inner buoyancy spaces, the pump room, boiler room, and engine room, each fitted with a quick-closing watertight door which is also arranged for hand-operations from the main deck.

The lifeboat equipment comprises two 26 foot standard boats of oregon pine and one 24 foot working motor dinghy equipped with a 2 d.m./18.5 b.h.p. "National" engine.

The boats are carried in patent davits of the "Welin" type. An adequate supply of life rafts and life buoys is provided.

The wireless-telegraphy installation which has been supplied by the Marconi International Marine Communication Co., Ltd., of London, includes a X.M.C./2 A. type, completely self contained wireless telephone and telegraph transmitter designed for point to point working. The set operates on a single wave length chosen

to suit the particular service at any spot wave between 150 and 450 meters. In cases where it might be required to communicate by telephony or telegraph using the normal 600 meter wave a unit for this purpose is located at the back of the transmitter and can be utilized by means of a rapid change over switch.

Under service conditions the ship's wireless set operates on a fixed wave length in communication with an independent shore station through which the movements and daily records of the dredger's working is reported to the board's head office.

Navigating Equipment

The outfit of magnetic compasses has been supplied by Messrs. Kelvin, Bottomley & Baird Ltd. of Glasgow, and comprises two of this firm's "Kelvite" pattern liquid card instruments supported on a solid teak pillar with patent suspension.

As previously mentioned, a British Admiralty silent magnetostriction, echo sounder with recorder, supplied by Henry Hughes & Son, Ltd. is installed for taking soundings over the dredging area.

Messrs. Siemens have supplied the installation of loud-speaking telephones communicating between the navigating bridge and the steering position on the poop deck, and between the propelling and pumping engine rooms, all inter-connected. The same firm has also installed an electric indicator for the ship's navigating lights and dredging signals.

(To be continued)

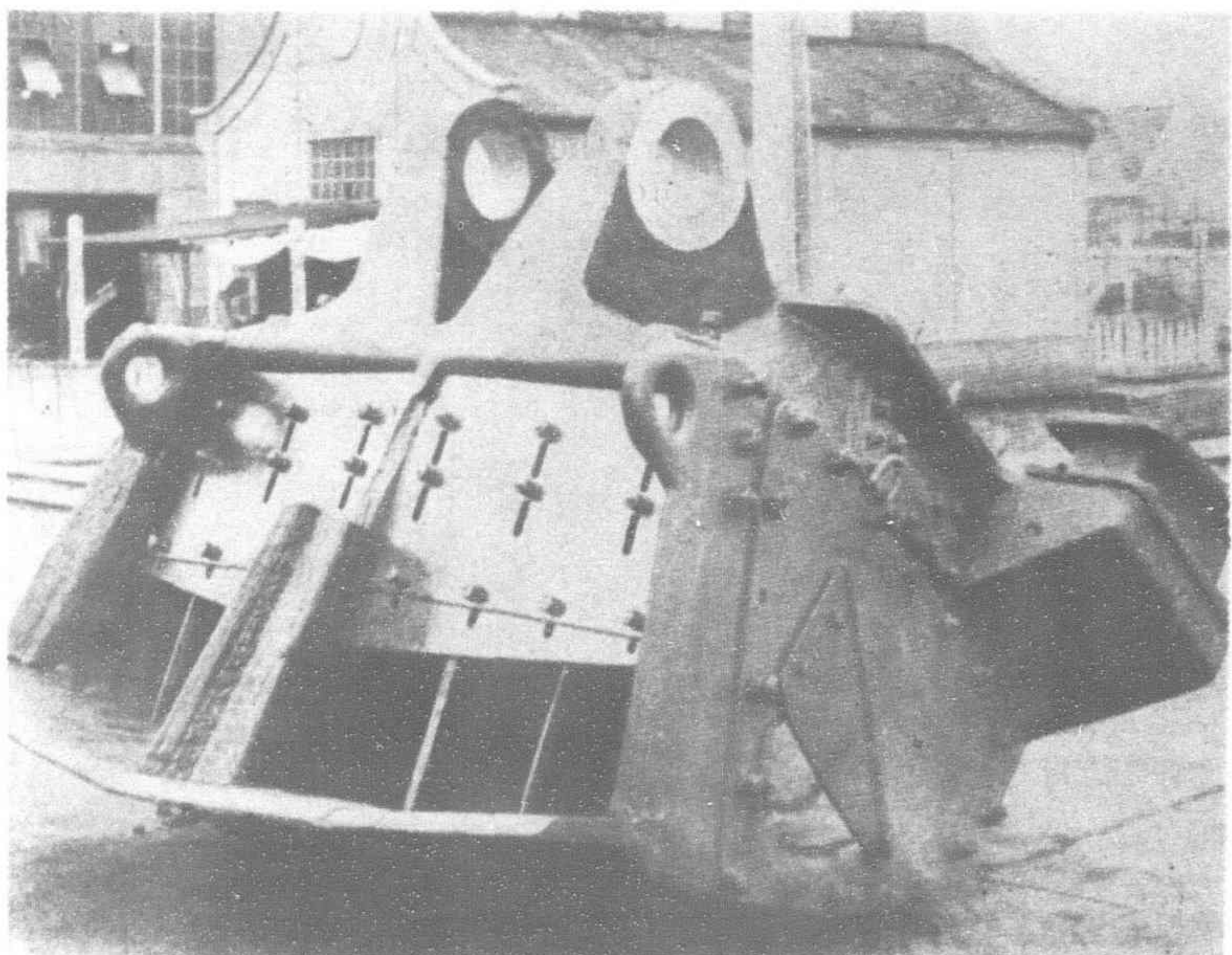


Fig. 8.—Front view of draghead showing cutting edge and grid plates

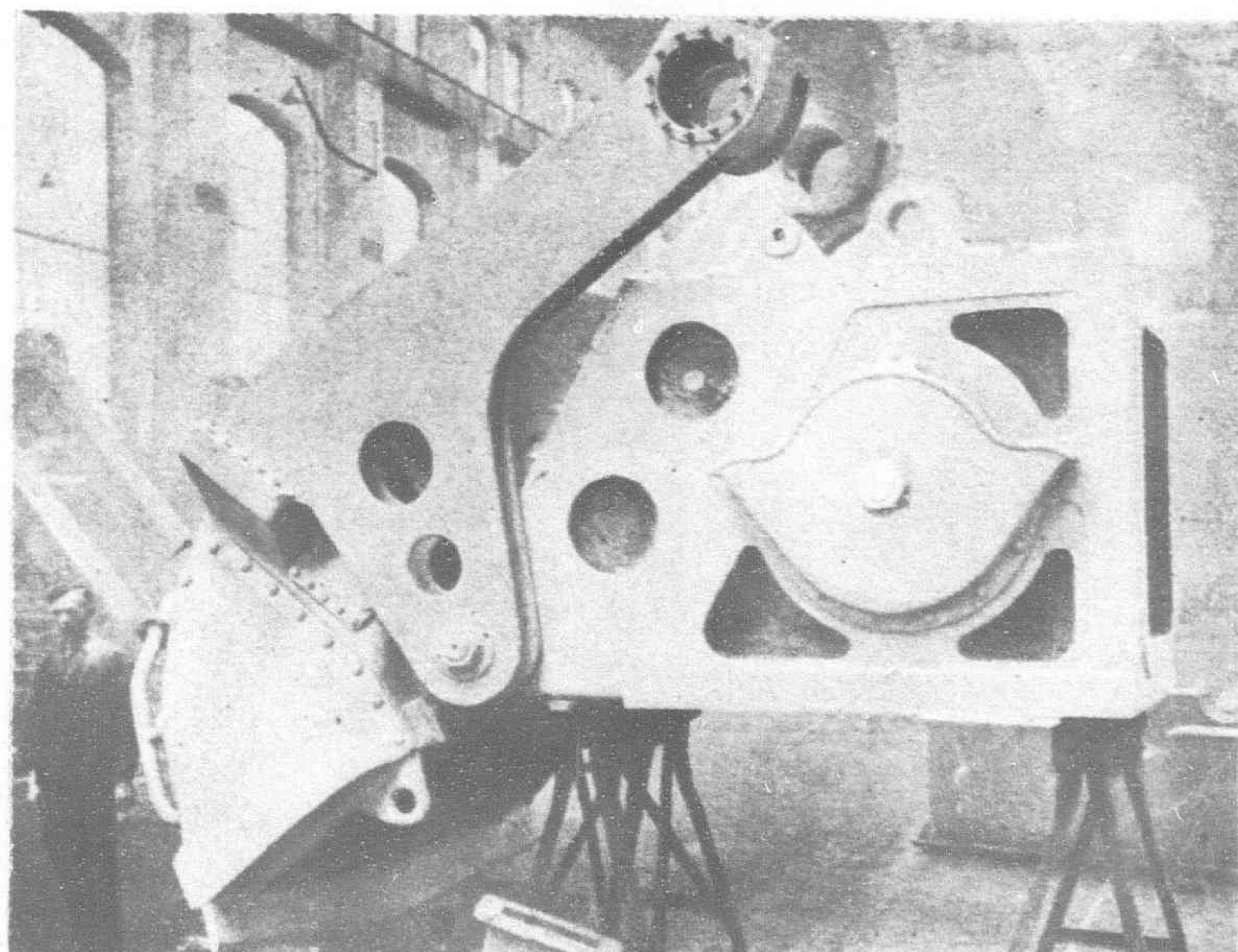


Fig. 9.—Side view of draghead showing side levers for angle control

Tramways in Shanghai, Tientsin and Peiping

By H. O. KUNG, B.S., Lecturer on Electric Railway Engineering, Hopei Institute of Technology, Tientsin

TRAMWAY systems are still the inevitable and the most efficient means for modern mass transportation service in all great centers of the world and they should be treated as one of the most important public utilities in modern civilization. On one hand, it is the duty of the head of any tramway concern to inform the public regarding their activities and operations in order to maintain their goodwill and public relations, while on the other hand, the public should keep a close watch on the transportation service. It is unwise for the tramway company to keep the public from knowing anything about tramway operations and it is equally unadvisable for the public to lose interest in the tramway operations of their own cities. It is the chief aim of this article to present those facts to the English reading public about the tramway operations of three great China cities and it is hoped to prepare also a similar article in Chinese in order to stimulate public interest among the Chinese people.

The Important Relationship between the Population and Tramway Operation

One of the first considerations in connection with the analysis of tramway operation is the study of the growth in population and the probable traffic. For the tramway system of a given city should not only serve the present needs of the community, but should be planned in advance so that the growth in the service demand may be facilitated and directed along the most desirable lines. The concentration of population in a great metropolis is generally caused by the increasing demand for space in the business districts and also by the side-by-side competition of theaters and other amusement houses. The so-called congested areas of a great metropolis has been considered as the principal factor for traffic accidents. It is the duty of the traffic police to see that the mingled fast and slow going vehicles and pedestrians keep pace with one another without causing accidents. It is much more important for a city transit engineer to provide fast, adequate, efficient and comfortable mass transportation service for the riding public. In order to furnish adequate service for the present and future it is necessary to know more about the present population. The growth for several years to come must be predicted. In order to do this intelligently it is necessary to know not only the growth in population in the past, but to study the causes of any deviations in the population curve. It is only after such a detailed study that the population curve may be accurately extended in determining the population to be expected ten to twenty years hence.

The Population of Shanghai

Shanghai is made up of three separate municipal areas;

the International Settlement, the French Concession and the surrounding municipal area of the City Government of Greater Shanghai. The growth in population of Shanghai has been most significant. Less than a century ago, Shanghai was an inconspicuous fishing town, yet to-day it is one of the largest populated centers of the World. The foreign population which numbered but 50 in 1844 grew to 23,307 by 1920 in the International Settlement alone. In 1935, there were 38,915 foreigners of fifty nationalities in the International Settlement. Records of the Shanghai population during the early years are lacking, but the number was estimated at 250,000 in 1870 and 1,000,000 in 1910. By 1928 the total population exceeded 3,000,000, placing Shanghai among the half dozen largest cities in the World. Table I is the combined population of the above-mentioned three municipal areas and is furnished by the Public Safety Bureau of the City Government of Greater Shanghai.

TABLE I.—THE GROWTH IN POPULATION OF SHANGHAI

1870	250,000 (estimated)	1931	3,294,219
1910	1,000,000 (estimated)	1932	2,378,805
1928	3,000,000	1933	3,212,040
1929	3,178,866	1934	3,408,108
1930	3,183,557	1935	3,529,120

The census in Table I includes all residents both in the French Concession and the International Settlement. It should be noted that the population in 1932 was one million less than that of the previous year. Presumably, it was due to the Sino-Japanese armed conflict at Shanghai in the early part of that year when a large number of residents left Shanghai during the trouble.

The rate of increase in population of Shanghai is some what amusing. During the period of 1870 to 1935, the average rate of increase per year is found to be 4 per cent, while for a recent period such as from 1928 to 1935, the average rate of increase per year is only 2 per cent. This will demonstrate the fact that the average rate of increase in population per year gradually decreases when the population of a city has passed the million mark.

Fig. 1 shows the population curve of Shanghai between 1928 and 1935, which is based upon the actual census during the past eight years. Fig. 2 shows the population curve of the same city but for a longer period (1870-1935) with certain estimates or assumptions made from the earlier 50 to 60 years.

Operating Data of Shanghai Tramways

Shanghai has three separate tramway organizations just as Shanghai is made up of three separate municipal areas. They are (1) The Shanghai Electric Construction Company, (2) The Chinese Tramways Company and (3) Compagnie Francaise de Tramways et d'Eclairage Electriques. Each company has its own right-of-

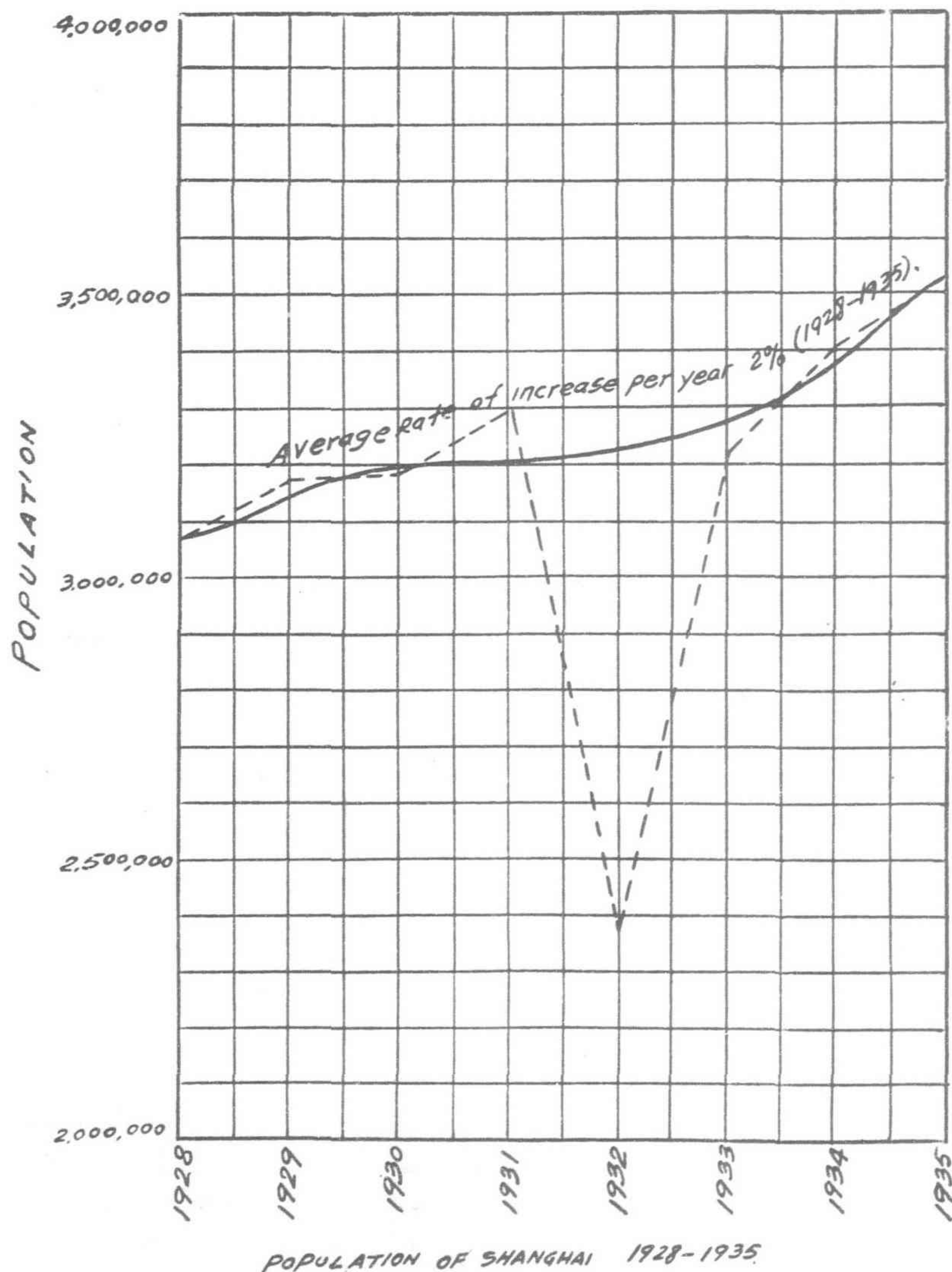


Fig 1

ways and its own franchise granted by these three respective municipal authorities. Particulars are unobtainable from either the Chinese Tramway or the French Company.

The Shanghai tramways in the International Settlement alone have a total route mileage of 18.09 miles for tramcars and 17.167 miles for railless cars, and 214 tramcars and trailers, and 99 railless trolley cars.

There are two types of trolley cars in Shanghai: one is the ordinary tramcar with steel wheels and the other is the railless trolley car or "trolley bus" as it is often called. It should be noted that both the Chinese and French tramway companies have no railless trolley cars. By special arrangement, however, railless trolley car service is being rendered by the British company in the French Concessions as extensions to their present existing routes in the International Settlement.

The analysis of operating data for the last five years of the Shanghai Electric Construction Co. is tabulated in Table II.

The third column indicates the total mileage of the tramway routes and the railless trolley routes. The fourth column represents the route mileage per 1,000 population. The value is rather low in this case, for the tramway mileage of both the French and the

Chinese tramway companies are not counted. Car-miles run in each year is given in the fifth column and the figures have been around 10 million car-miles each year.

The revenue from passengers given in the sixth column shows a big drop in 1932. Presumably, it was due to the competition by the China General Omnibus Co. which previously had 120 vehicles in operation, and added 44 buses during that year, making a fleet total of 164 modern comfortable buses operating in the International Settlement. Although bus fares are a little higher than that of the tramways, the leather cushioned, comfortable seats of the buses have attracted millions of passengers who otherwise would patronize the tramways.

The seventh column gives the number of passengers per capita of population and it is evident that the tramways are gradually losing their patronage (from 42 passengers per capita in 1931 dropped to 32 in 1935).

The eighth column gives the gross revenue during each year of the Shanghai Electric Construction Co. These figures are computed from the financial statement of the Annual Report of the Shanghai Municipal Council, for it was specified in the franchise that the Tramway Co. shall pay to the S.M.C. a royalty of 5 per

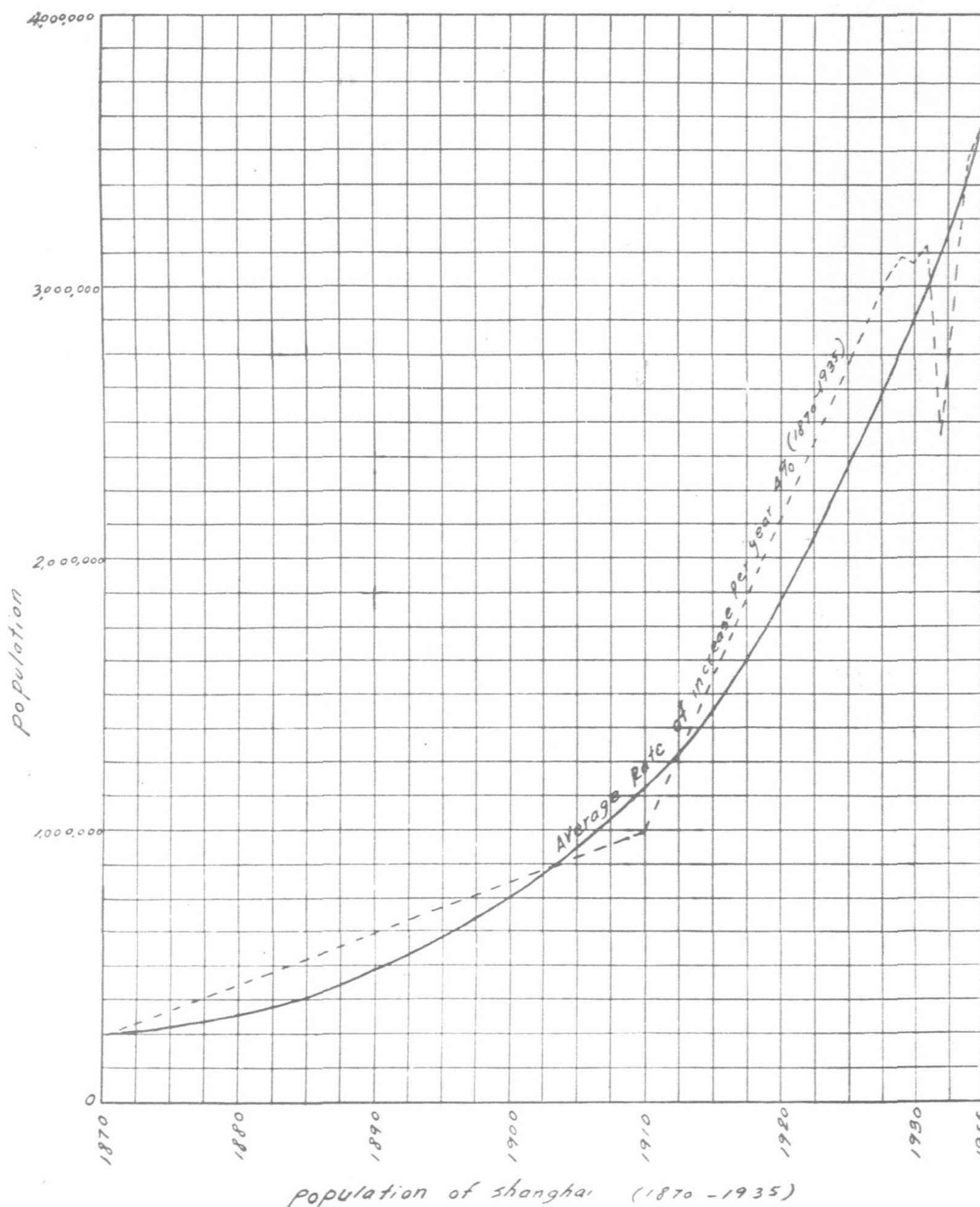


Fig. 2

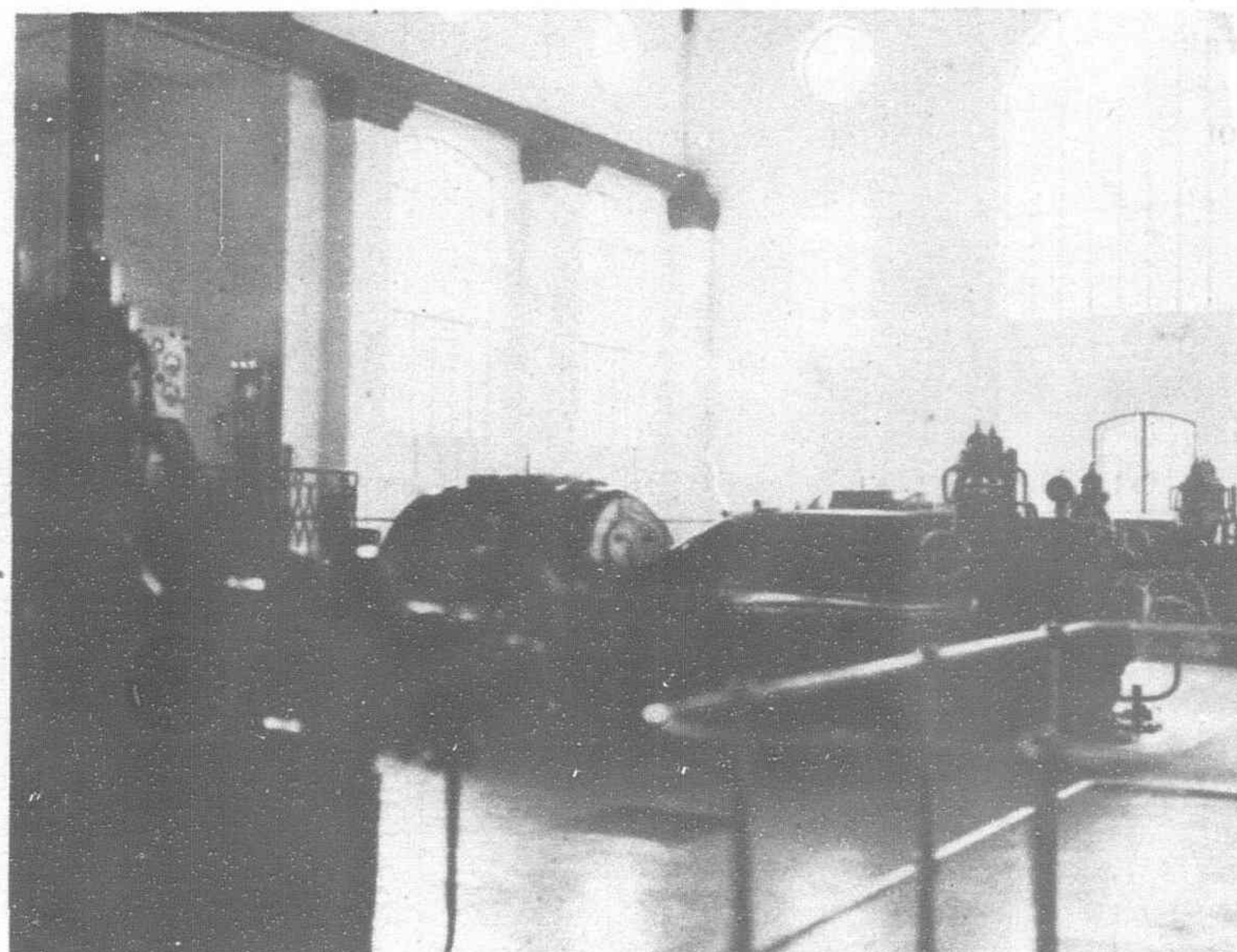
TABLE II.—OPERATING DATA OF THE SHANGHAI ELECTRIC CONSTRUCTION CO. (SHANGHAI TRAMWAY CO.)

Year	Population	Total route-mileage	Route mileage per 1,000 population	Car-miles run in the year	Revenue passengers carried	Passengers per capita	Gross revenue in Dollars	Earnings per car-mile	Remarks
1931	3,294,219	35.039	0.01064	9,739,936	139,800,061	42.45	3,001,569	30.83 cts.	102 Tramcars 100 Trailers 98 Railless cars.
1932	2,378,805	35.253	0.01488	9,407,656	108,845,656	45.76	2,266,076	24.11 cts.	102 Tramcars 100 Trailers 98 Railless-cars
1933	3,212,940	35.253	0.01100	10,560,351	119,669,536	37.24	2,475,514	23.45 cts.	107 Tramcars 107 Trailers 98 Railless cars
1934	3,408,188	35.257	0.01037	10,655,430	119,687,484	34.08	3,385,063	31.80 cts.	107 Tramcars 107 Trailers 99 Railless cars
1935	3,529,120	35.257	0.01000	10,627,132	115,201,428	32.70	3,191,695	30.024	do.

Tramways: Route mileage of tracks, 18.090 miles.
Track mileage in terms of single track, 34.706 miles.
Trolley Buses: Route mileage, 17.167 miles.



Campus of the French Power Station with two water cooling towers in background



Turbine room of the French Power Station

cent on gross receipts from tramway operations. It is believed that the computed revenue figures represent fairly well the actual gross receipts of the Company. So far as gross revenue is concerned, the operation of the tramway company shows a fair yield in earnings.

The earnings per car-mile is given in the ninth column and it varies between 23 to 31 cents per car-mile and the average figure for the last five years is calculated to be 27.5 cents per car-mile.

It will be noted in the last column that during the past five years only five tramcars, seven trailers and one railless trolley car have been added to the fleet totaling 313 vehicles while the omnibus company has added 45 ordinary buses and 24 double-deck buses during the same period, making a fleet total of 192 vehicles of which 24 are double-decked.

The "riding habit" or the number of passengers per capita of population per annum given in the seventh column of Table II does not represent the whole of S'hai, for passengers who patronized the two other tramways and three to four other bus companies' services have not been included in the tabulation. The riding habit of the Shanghai population must be higher than that given in the seventh column of Table II. Table III illustrates the higher figure of the riding habit when both the tramways and omnibus services in the International Settlement are considered.

TABLE III.—RIDING HABIT OF SHANGHAI POPULATION

Year	Population	Passengers carried by tramcars	Passengers carried by buses	Total passengers carried	Passengers per capita per annum	Remarks
1933	3,212,040	119,669,536	31,599,707	151,269,243	47.1	
1934	3,408,188	119,687,484	36,363,276	156,050,760	45.7	
1935	3,529,120	115,201,428	37,328,561	152,529,989	43.2	

Note :—There are still some other passengers, utilizing the bus service furnished by the Chinese and French omnibus companies, which are not included in the above table. Consequently, the riding habit should be somewhat higher than the above figures.

It is seen that the number of passengers per capita of population per annum is as high as 47. If the number of passengers patronizing the Chinese and French tramways and other bus service are included, the riding habit of the Shanghai population can be well above 50 passengers per capita. In other words, each of the Shanghailanders will have 50 rides in either the tramcars or omnibus in a year.

The Population of Tientsin

Tientsin is a modern commercial and industrial center with a seaport located in its south-east end 40 miles from the city. Although Tientsin has been considered as one of the most important treaty ports in North China, it is, in fact, not the best suitable sea-

port after all, because large vessels with cargo for Tientsin have to discharge their freight outside Taku Bar whereas a tremendous amount of silt has accumulated owing to a number of muddy tributaries in the Hopei Province. However, it has good rail connections leading to north, south and west and serving a far-flung section of inner Asia.

Prior to 1928, no precise census enumeration was ever taken in Tientsin. It is estimated, however, that the population of Tientsin was about 60,000 in the year 1860. In the October of that year Tientsin was made a Treaty Port by the Anglo-French-Chinese Convention conducted and signed in Peking. By 1900, the Tientsin population was estimated to be 320,000. Statistics differ widely in the figures for Tientsin's population and yet each report is incomplete. The China Year Book indicates the Tientsin population being 838,629 in 1922. While the *Economic Bulletin* gave a population figure of 1,391,721 for 1929. Another source indicates the population of Tientsin in 1931 was 1,387,462. The Statistical Report of the Tientsin Municipal Government gave a population figure of 1,399,146 for 1933. The North-China Hong List gives a population figure of 1,348,905 for 1935.

The Tientsin Public Safety Bureau have no records available for the municipal population up to 1932. Yet the census quoted by the Bureau for the last two years seem to be somewhat under the actual population. Table IV gives the population of Tientsin in a number of years, which is believed to be representative of the facts.

TABLE IV.—POPULATION OF TIENTSIN

1860	..	..	60,000 (estimated)	1931	..	..	1,387,462
1900	..	..	320,000 (estimated)	1933	..	..	1,399,146
1922	..	..	838,629	1934	..	..	1,391,721
1929	..	..	1,391,721	1935	..	..	1,348,905

The inhabitants in the British, French, Italian and Japanese Concessions and also in the suburbs within municipal boundaries are all included in the above Table.

It will be seen from the population curve (Fig. 3) that the population of Tientsin has decreased during the past two years and the average rate of decrease per year during the past two years is found to be 1.8 per cent. Such a decline in population must have been contributed by the factors of the general economic depression and the removal of the provincial capital from Tientsin to Paotingfu in 1935. Taken as a whole, however, the population of Tientsin has been on the up trend for many years and the average rate of increase per year during the period of 1860 to 1935 is found to be 4.2 per cent.

The Charter of the Tientsin Tramways

The Tientsin Tramway Co. (Compagnie de Tramways et d'Eclairage de Tientsin) obtained their Charter early in 1904 from Mr. Yuan Shih-kai, then Governor-General of Chihli Province by Mr. E. Heyl of E. Meyer & Co. It was stipulated in Article 2 of the Charter that "Mr. E. Heyl shall form a public company to

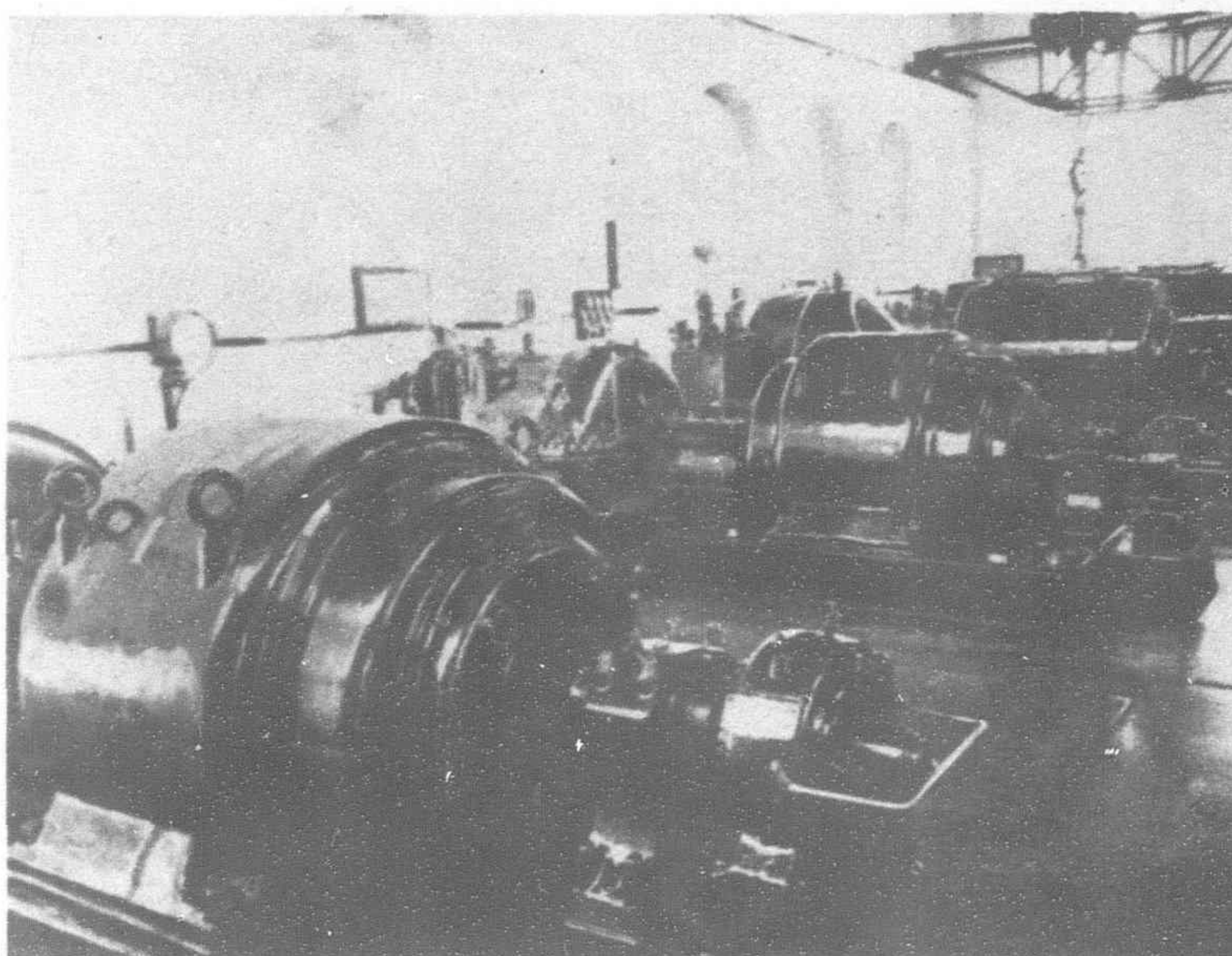
take over the concession for electric tramways and lighting of Tientsin; the said company is hereby authorized by the Chinese authorities, with an initial capital of £250,000 under the name of Tientsin Tramways and Lighting Co., or *Compagnie de Tramways et d'Eclairage de Tientsin*." It was also stated in Article 15 that "after the Company has run the electric tramways for fifty years, calculating from the day of opening traffic, all the tracks, buildings, lumber, land, machinery, etc., in the territory of the local authorities and in the foreign concessions in Tientsin, shall be presented to the Chinese authorities for nothing." It was indicated in another article that the local authorities may buy back the whole plant after twenty years from the running of the electric tramways or at intervals of seven years subsequently. The tramway operation was actually commenced in 1906, so the franchise will extend to 1956.

Article 12 of the Charter stipulates the conditions of paying royalties to the Chinese authorities; that "the Company shall pay every year to the local authorities a sum equal to three and a half per cent ($3\frac{1}{2}\%$) of the gross earnings of the undertaking before payment of working expenses, salaries, or any other disbursement whatsoever. When the Company shall be in a position to pay twelve per cent (12%) dividend on its capital, the Company shall pay to the Chinese Government, besides the above $3\frac{1}{2}\%$, a bonus of ten per cent (10%) of its net profits after payment of said dividend; and after payment of fifteen per cent (15%) dividend upon the capital, the Company shall pay to the Chinese Government, in addition to the above $3\frac{1}{2}\%$, a bonus of twenty per cent (20%) on its net profits."

In 1927, Article 12 of the said Charter was revised and amendment was made as follows:—

- (a) When the gross earnings for one year are less than one million dollars, three and a half per cent ($3\frac{1}{2}\%$) shall be paid by way of royalties to the Chinese Authorities.
- (b) When the gross earnings being over one million dollars but below two million dollars, then, eight per cent (8%) shall be paid by way of royalties to the Chinese Authorities.
- (c) When the gross earnings being over two million dollars, then, ten per cent (10%) shall be paid by way of royalties to the Chinese Authorities.

There are many peculiar and interesting provisions in the Charter, but space does not permit to discuss these at length in this article. The writer intends to prepare another article to give



Turbine room of the British Power Station (7,500 kva)

a full account relating to the development of electric public utilities in Tientsin.

Operating Data of the Tientsin Tramways

The Tientsin Tramways Co. has all five different routes of tramways, designated as red, yellow, blue, white and a double color of red and blue, making a total route mileage of 13.443 kilometers, and has a rolling stock of 70 tramcars and 60 trailers.

Unlike the Shanghai Tramways Co. which must report its operations to the Shanghai Municipal Council and consequently published in the S.M.C. Annual Report, the Tientsin Tramways Co. has never made public report relating to its

operations. Consequently, very little information is obtainable. The writer has written to the Company and requested its operating data. Fortunately, the request has been granted. Together with some other particulars, the operating data and other calculated results are fully given in Table V.

Table V gives the operating data of the Tientsin Tramways for the last nine years from 1927 to 1935. The second column gives the population of the past nine years and some of the figures were scaled off from the population curve (Fig. 3). The length of the track is given in the third column and it is seen that there have been very little changes about track mileage. It varies only from 13.495 kilometers in 1927 to 13.443 kilometers in 1935. The fourth column gives the track kilometers per 1,000 population and it varies from 0.01058 to 0.00965 kilometers per 1,000 population. The fifth column gives the total car-kilometers run each year and it is seen that the total car-kilometers increases with the year. It means that for the same length of track, the Tramways Company must have operated more cars and rendered more frequent service to the public. The total number of revenue passengers carried each year is given in the sixth column, disclosing the fact that the total number of revenue passengers has been decreasing. The riding habit or the number of passengers per capita of population is given in the seventh column and it varies between 43 to 66, averaging at about 52 passengers per capita. The gross revenue from tramway operation is quoted in the eighth column, indicating that it had always been over a million dollars for any one year. Earnings per car-kilometer in dollar cents are given in the ninth column, indicating an average earning of 22.59 dollar cents for each car-kilometer run.

It should be noted that with considerable increase in the total car-kilometers run each year, yet the revenue passengers carried

TABLE V.—OPERATING DATA OF THE COMPAGNIE DE TRAMWAYS ET D'ECLAIRAGE DE TIENTSIN

Year	Population	Length of tracks in kilometers	Track kilometers per 1,000 population	Total car kilometers	Revenue passengers carried	Passengers per capita	Gross revenue in Dollars	Earnings per car km.	Remarks
1927	1,275,000*	13.495	0.01058	4,969,282	85,260,237	66.9	1,051,384	21.17 cts.	70 Tramcars 60 Trailers
1928	1,360,000*	13.495	0.00991	4,746,728	75,324,003	55.4	1,194,245	25.19 cts.	do.
1929	1,391,721	13.495	0.00969	4,389,684	74,302,271	53.4	1,223,427	25.60 cts.	do.
1930	1,385,000*	13.495	0.00974	5,251,722	74,914,027	54.1	1,252,476	23.84 cts.	do.
1931	1,387,462	13.495	0.00973	5,196,024	72,534,142	52.3	1,235,974	23.79 cts.	do.
1932	1,375,000*	13.492	0.00990	5,233,970	59,803,601	43.5	1,238,971	23.65 cts.	do.
1933	1,399,146	13.492	0.00965	5,387,286	63,403,000	45.4	1,143,970	21.25 cts.	do.
1934	1,391,721	13.492	0.00969	5,532,722	67,480,136	48.4	1,103,967	21.10 cts.	do.
1935	1,349,905	13.443	0.00997	5,863,510	64,058,359	47.6	1,043,153	17.78 cts.	do.

*Scaled from the population curve.

each year have been declining. Presumably, this was caused by the popular adoption of bicycles in North China. For a southern visitor had usually been surprised with so many cyclists in the various streets of Tientsin. The situation of bus competition has not been very keen in Tientsin, because most of the bus routes, instead of running parallel to the tramways, act as feeders to the tramway service.

One of the peculiarities relating to the tramway operating data of Tientsin is that an increase in the total car-kilometers run does not ensure a proportionate increase in revenue passengers, nor a proportionate increase in gross receipts.

The Population of Peiping

Peiping has long been the cultural and educational center of China, thousands and thousands of students coming from all parts of the country to acquire training in a great number of institutions. The removal of The Capital from Peiping to Nanking in 1928 caused the closing down of thousands of shops and its prestige among all other Chinese cities has thus been overshadowed. However, Peiping has been considered to be the best residential city in the whole of China; unlike the noisy and overcrowded state in Shanghai or Tientsin, Peiping presents a picture of distinctive charm and possesses numerous expressions of architectural genius and highly reputable scenery.

The census of Peiping has been taken each year since the formation of the Chinese Republic. Table VI is an abstract from the Census Report of the Public Safety Bureau of Peiping Municipal Government.

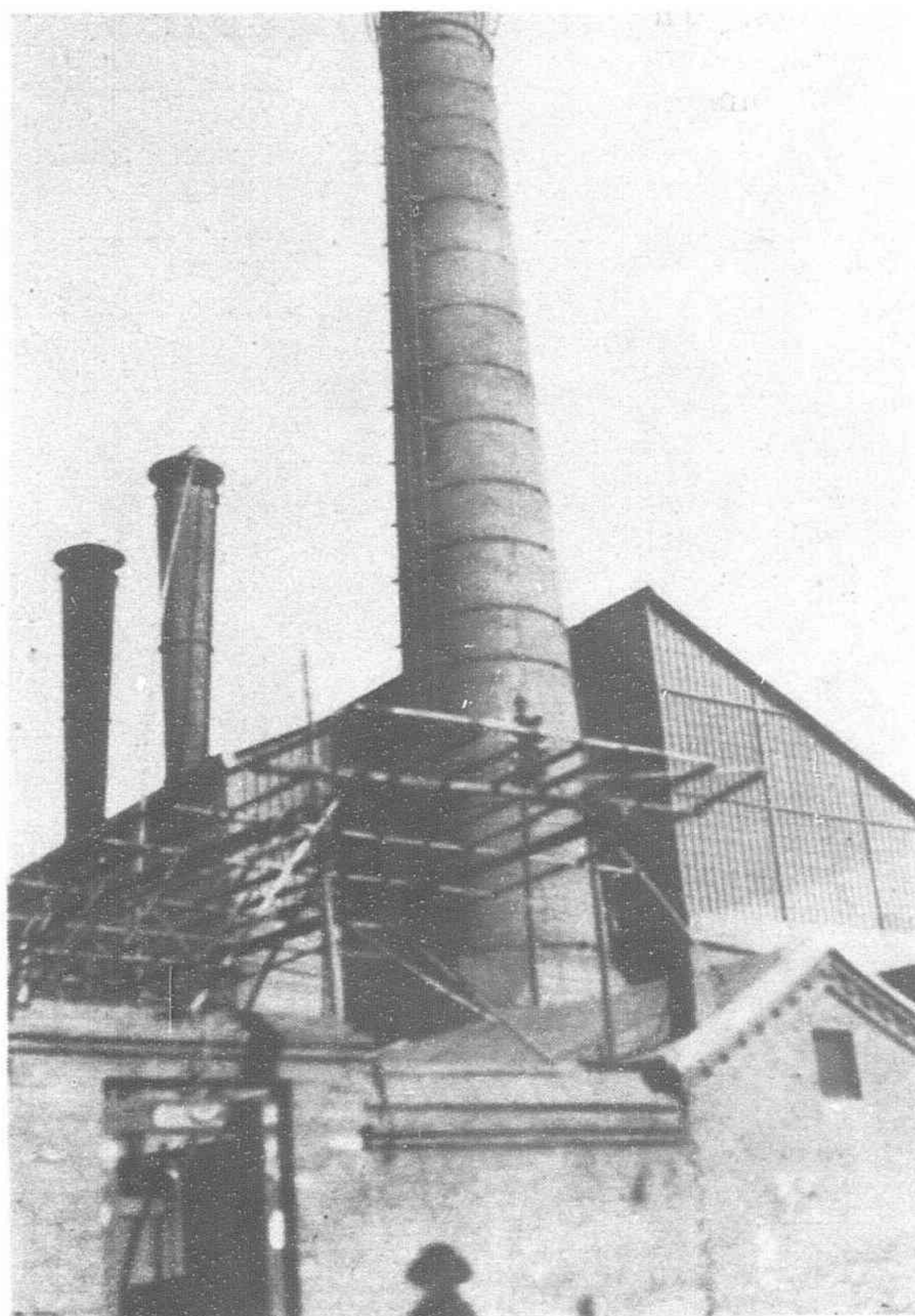
TABLE VI.—POPULATION OF PEIPING

1912	..	..	725,235	1924	..	..	872,576
1913	..	..	668,403	1925	..	..	1,266,148
1914	..	..	769,317	1926	..	..	1,224,414
1915	..	..	789,123	1927	..	..	1,317,734
1916	..	..	801,136	1928	..	..	1,358,630
1917	..	..	811,556	1929	..	..	1,370,044
1918	..	..	799,395	1930	..	..	1,383,873
1919	..	..	826,531	1931	..	..	1,419,099
1920	..	..	849,554	1932	..	..	1,500,231
1921	..	..	863,209	1933	..	..	1,514,587
1922	..	..	841,945	1934	..	..	1,570,643
1923	..	..	847,107	1935	..	..	1,564,869

TABLE VII.—OPERATING DATA OF THE PEIPING ELECTRIC TRAMWAY CO., LTD.

Year	Population	Revenue passengers carried	Passengers per capita	Gross revenue in Dollars	Total expenditure in Dollars	Operating ratio	Car kilometers	Earnings per car kilometer	Remarks
1926	1,224,414	22,885,299	18.67	727,866	789,766	loss	4,161,991	17.48 cts.	
1927	1,317,734	26,108,782	19.86	828,957	774,680	6.5%	4,736,133	17.50 cts.	
1928	1,358,630	25,899,717	19.08	888,527	1,146,112	loss	4,755,182	18.61 cts.	
1929	1,370,044	22,701,220	16.57	1,002,281	1,081,869	loss	4,347,185	23.08 cts.	
1930	1,383,873	21,059,586	15.19	941,722	1,140,655	loss	4,936,021	19.07 cts.	
1931	1,419,099	22,972,309	16.19	1,100,947	1,253,337	loss	4,838,386	22.76 cts.	
1932	1,500,231	26,773,270	17.84	1,207,314	1,101,373	8.7%	4,684,189	25.75 cts.	
1933	1,514,587	22,786,930	15.02	1,216,544	1,256,365	loss	4,341,687	28.01 cts.	
1934	1,570,643	22,249,280	14.18	1,108,994	1,144,979	loss	4,589,056	24.14 cts.	
1935	1,564,869	20,055,162	12.80	1,079,903	1,079,168	loss	5,023,298	21.45 cts.	

NOTES :—Total number of cars, 96.
Total kilometers of track 47.766 mk.



Exterior view, of Belgian Power Station which supplies power for the tramways

It should be noted that the population of Peiping in 1925 was 1,266,148 which is almost 40,000 more than that of the preceding year. The cause of such a great increase was not stated in the Census Report. Presumably, it was due to the enlargement of the Municipal area by adding the population of the suburbs to the total figure. However, the average rate of increase per year for the 1912-1935 period is only 3.5%, which is found to be very usual with that of the other large cities in the World. Contrary to the common belief that the population of Peiping must have been decidedly decreasing since the removal of the Capital in 1928, it has, on the other hand, been steadily growing.

Fig. 4 is the population curve of Peiping during the period of 1912 to 1935.

The Operating Data of Peiping Electric Tramway Co.

The Peiping Electric Tramway Co. was organized in 1921 with a capital of \$4,000,000 and tramway operation was commenced in December of 1924. The power station of the Tramway Company is situated near Tungchow, having 6,000 kva capacity with a generated voltage at 5,250-volts and transmission line voltage at 33,000-

volts. The trolley circuit in the city is of 600-volts D.C. There are 47.766 kilometers of tramways and altogether 96 tramcars, of which 65 being motored vehicles and 31 trailers. There are six different tramway routes, designated by numbers, from Route No. 1 to Route No. 6.

Table VII gives the important particulars for the ten years' operation and analysis. In the third column, is given the revenue passengers carried each year during the last ten years and it varies from 20 to 26 million passengers per year. The riding habit or the number of passengers per capita of population varies from 12 to 19, giving an average value of 16 passengers per capita per annum, which is considerably lower than that of Shanghai or Tientsin. The gross revenue from tramway operations is given in the fifth column and it varies from 727,866 to over a million. The total expenditure varies from \$774,680 to \$1,253,337, showing operation losses in eight out of ten years. The operating ratio, which is defined as the ratio of the net income to the total gross income, is given in the seventh column, indicating that the

Tramway Co. must have been in financial straits. The car-kilometers run each year is given in the eighth column and it has been always over four million car-kilometers every year.

Comparison of the Earnings of the Three Tramway Companies

The annual gross revenues of the Tientsin and Peiping Tramways are approximately equal to each other, while the Shanghai Tramways have an annual revenue of two to three times that of either Tientsin or Peiping Tramways. However, it is customary to compare the earnings of tramway companies in terms of car-mile or car-kilometer. Table VIII gives the earnings per car-mile or car-kilometer of the Shanghai, Tientsin and Peiping Tramways. It will be seen that the average earnings of the Shanghai Tramways for the last five years was 28.25 cents per car-mile. The average earnings of Tientsin Tramways during the past ten years was 21.78 cents per car-kilometer and that of Peiping Tramways was 22.59 cents per car-kilometer.

TABLE VIII.—EARNINGS PER CAR-MILE OR CAR-KILOMETER

Year	Per car-mile	Per car-kilometer		Remarks
	Shanghai	Peiping	Tientsin	
1926		17.48 cts.		
1927		17.50 cts.	21.17 cts.	
1928		18.61 cts.	25.19 cts.	
1929		23.08 cts.	25.60 cts.	
1930		19.07 cts.	23.84 cts.	
1931	30.83 cts.	22.76 cts.	23.79 cts.	
1932	24.11 cts.	25.75 cts.	23.65 cts.	
1933	23.45 cts.	28.01 cts.	21.25 cts.	
1934	32.83 cts.	24.14 cts.	21.10 cts.	
1935	28.25 cts.	21.78 cts.	22.59 cts.	
Avg.	28.25 cts.	21.78 cts.	22.59 cts.	

NOTES :—

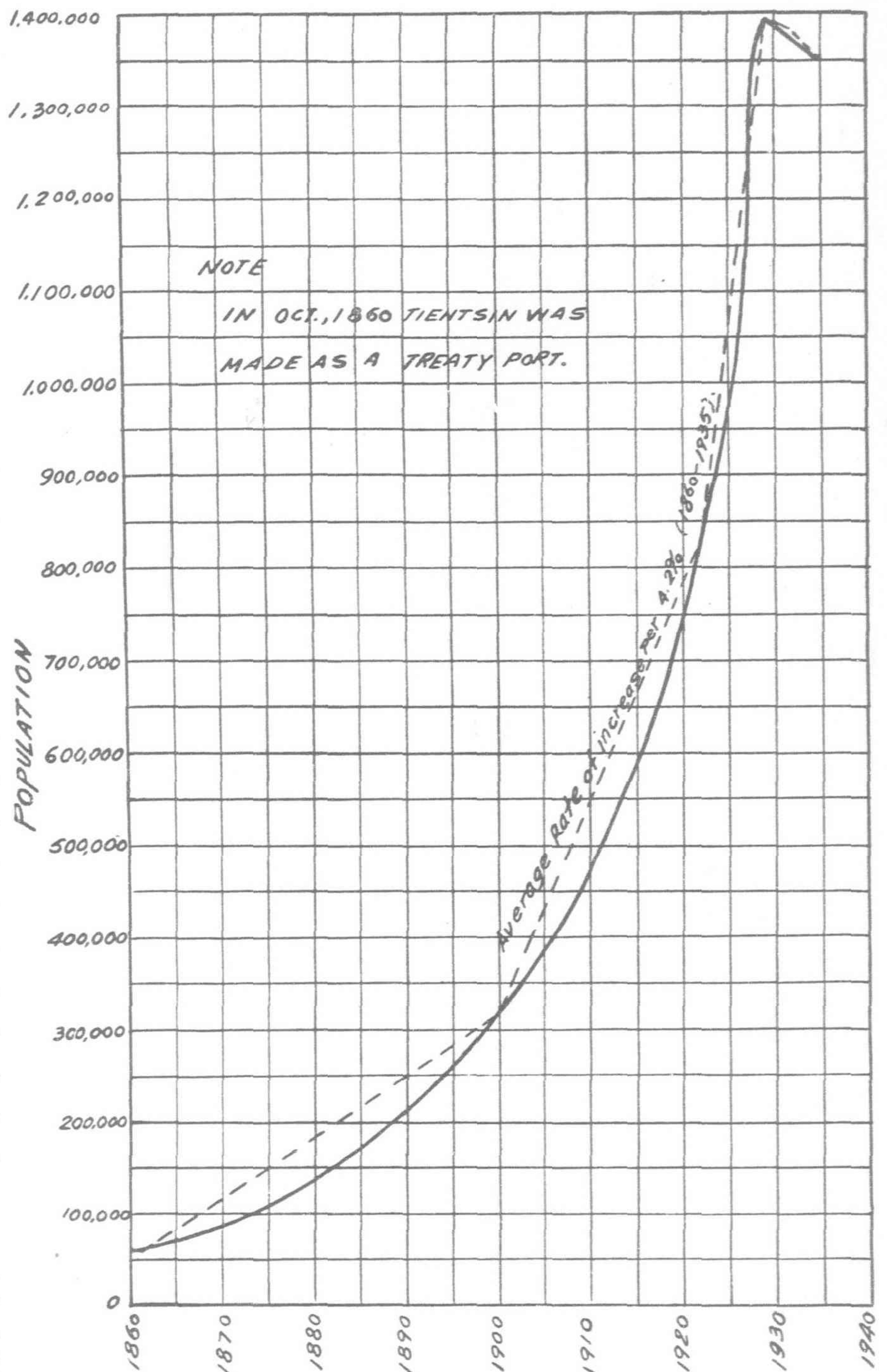
City	Total car-miles in 1935	Total car-kilometers in 1935	Average earnings per car-mile	Average earnings per car-kilometer
Shanghai	10,627,132	17,010,000*	28.25 cts.	17.67 cts.
Peiping	3,112,000*	5,023,298	35.12 cts.	21.78 cts.
Tientsin	3,637,000*	5,863,510	36.44 cts.	22.59 cts.

* Equivalent values.

It is interesting to note that both Tientsin and Peiping Tramways have had over 4,000,000 car-kilometers run each year, but the revenue passengers carried annually by the Peiping Tramways are only one-third of the revenue passengers carried by the Tientsin Tramways. It is no wonder why the Tientsin Tramways are making ample profit while the Peiping Tramways lose each year. However, the earnings per car-kilometer are lined up at approximately the same average figure with both Tientsin and Peiping Tramways. It is evident that Peiping Tramway fares must be considerably higher than that of the Tientsin Tramways.

The equivalent car-miles or car-kilometers run during the year of 1935 of the three tramway companies in China and the average earnings per car-mile or the equivalent earnings per car-kilometer of the said companies are all given in the footnote of Table VIII. It is quite clear that the total car-miles operated by the Shanghai Tramways are approximately three times that of either Tientsin or Peiping. The average earnings per car-mile is the highest in Tientsin and the lowest in Shanghai.

If the operating cost per car-mile is all the same for these three companies, it would lead to the belief that Tientsin Tramways must have earned much more profit than the Shanghai Tramway Company. Unfortunately, the figures for the expenditure of both the Shanghai and Tientsin Tramways are unavailable to the writer,



POPULATION OF TIENTSIN 1860-1935. Fig. 3

it is, therefore impossible to calculate the operating ratio of the two companies.

Comparison of the Riding Habit

The "riding habit" is defined as the number of passengers per capita of population per annum for a given transportation facilities in a community or a municipality. It is an indication as how the transportation facilities are adopted by the community.

In the old days people lived together in a rather small community and they stayed in the vicinity of their working places. Consequently, there was very little need of daily travelling facilities for any great distance. But now the situation has changed. Large factories demand a great number of workmen and these workmen have to live outside the factory. In a very large industrial center, workmen have to travel several miles from their living quarters to their working places. On account of the limited space in the business district of a large city or a metropolis, traders and shopkeepers have to live in the outskirts of the city. They, too, have to travel great distances from their residences to their offices, shops, etc. Gradually, it becomes a habit to ride in the street

car or omnibus, etc., to travel back and forth between the places they live and work. It is an undeniable fact that very few business men are living in the business districts, such as Nanking Road in Shanghai; instead they choose their residences in the more remote districts where the environment is best suited for living. Unless they own an automobile they have to use the service of tram-cars or omnibus.

Riding habit of the people has some bearing on the population. That is, the greater the population of a city, the higher the riding habit. In the United States of America, however, riding habit does not increase in proportion with the population, but it seems to be saturated at a certain point. In a city of over five million inhabitants, in America, the riding habit seems to reach a peak at 320 passengers per capita of population per annum.

In a comparative study of riding habit for European and American populations, Prof C. F. Harding of Purdue University found that for a city of one million population, the riding habit is about 230 in Great Britain, 260 in France, 265 in America and 320 in Germany.

Table IX gives the riding habit of Shanghai, Peiping and Tientsin. It will be seen in the footnote under the Table that the average riding habit is 38 for Shanghai, 51 for Tientsin, and 16 for Peiping.

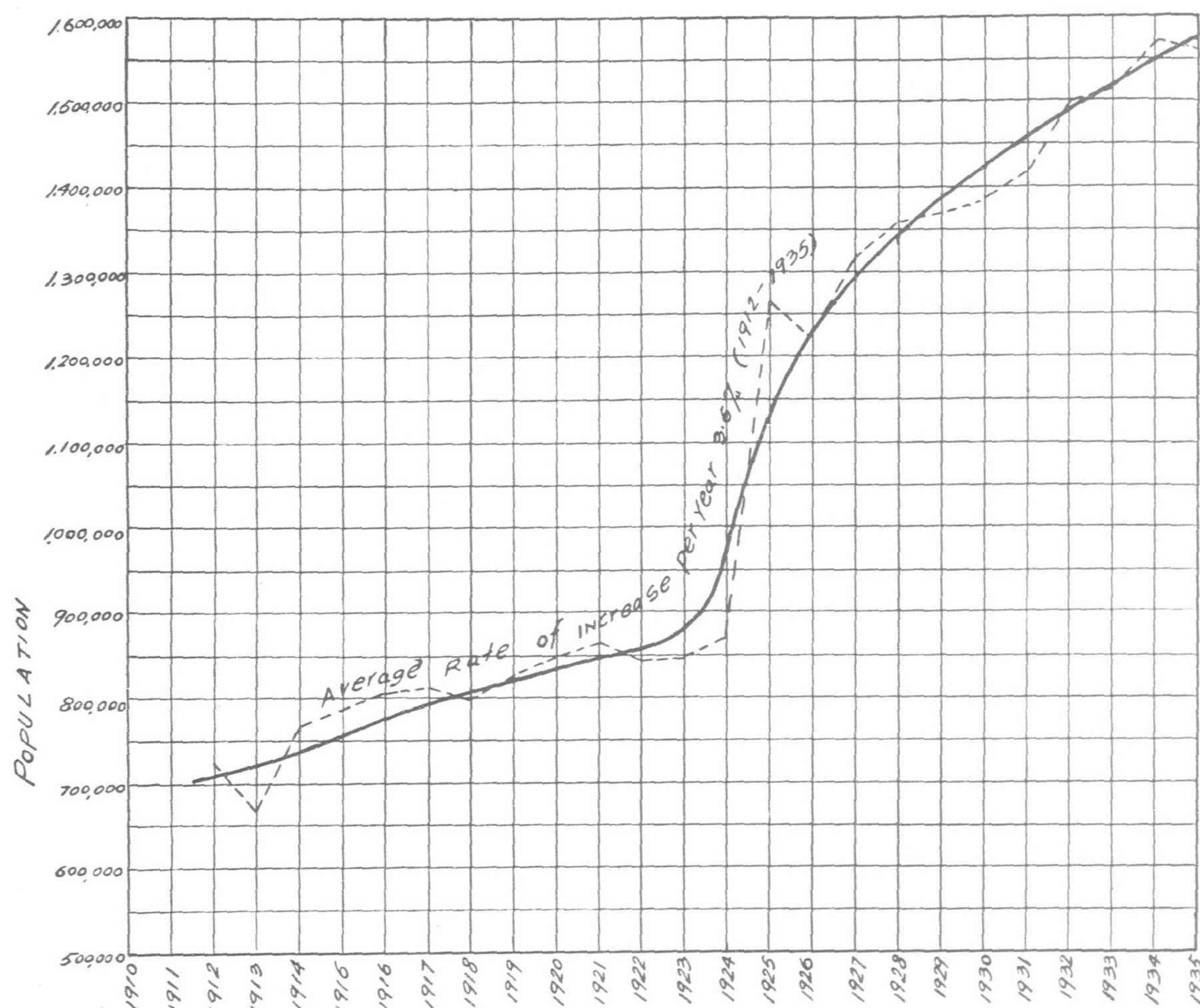
TABLE IX.—RIDING HABIT
(Number of Passengers per capita of population per annum).

Year	Shanghai	Peiping	Tientsin	Remarks
1926		18.67		
1927		19.86	66.90	
1928		19.08	55.40	
1929		16.57	53.40	
1930		15.19	54.10	
1931	42.45	16.19	52.30	
1932	45.76	17.84	43.50	
1933	37.24	15.02	45.40	
1934	34.08	14.18	48.40	
1935	32.70	12.80	47.60	
Avg.	38.44	16.54	51.88	

NOTES:—

City	Population in 1935	Average riding habit
Shanghai	3,529,120	38.44
Peiping	1,564,869	16.54
Tientsin	1,348,905	51.88

It should be added that the foregoing figures for riding habits of Shanghai, Tientsin and Peiping are calculated for the tramway service only. The combined riding habit for all mass transportation vehicles should be somewhat higher. For instance, the China General Omnibus Company of Shanghai has a fleet of 192 buses



POPULATION OF PEIPING 1912-1935.

Fig. 4

and carried 37,328,561 passengers in 1935. The combined riding habit for the Shanghai population will thus be advanced from 38 to 43.

Table III has given the total passengers carried by tramcars and buses and also the combined riding habit of tramcars and buses in Shanghai.

It should be noted that there are still two tramways, one in the French Concession and the other in Nantao of the Chinese City, and two or three more omnibus companies operating in the area other than the International Settlement. If all these public passenger carrying vehicles are counted together, the total combined riding habit for the Shanghai population would be much higher than 43, possibly reaching 60.

The riding habit of Peiping population is exceedingly low as compared with the other two cities. As it has been said before that Peiping is the best residential city in China and shopkeepers generally stay right in their shops and few workmen are rich enough for daily use of the tramway service. Most passengers in the tramcars of Peiping are in government service, or students, etc.; very few are business men or factory workers.

Summary and Conclusion

Shanghai, Peiping and Tientsin are, in fact, the first three largest cities of China. The population and the number of revenue passengers carried in 1935 for each city are as follows:—

City	Population	Revenue Passengers
Shanghai	3,529,120	151,269,243
Peiping	1,564,869	20,055,162
Tientsin	1,348,905	64,058,359

Tramcars and omnibus have been considered as the best means available for mass transportation service in great metropolitan areas. The total route mileage of tramways and omnibus in a modern city determine to some extent the quality of their service. It would be undoubtedly true that the longer the tramways or bus routes, the better the transportation company can serve the riding

public. Exclusive of the route mileage of tramways and bus routes in the French Concession and in the Chinese municipal area (of which information is lacking) the mileage of tramways and bus routes in Shanghai and in the other two largest cities of China will have the following standing :—

Shanghai	Route mileage of tramways ..	18.090 miles
(In the	Track mileage in terms of single	
International	tramway track	34.706 miles
Settlement	Railless trolley route mileage ..	17.167 miles
only)	Omnibus route mileage	—
Peiping	Tramway track mileage	47.766 kilometers
Tientsin	Tramway route mileage	13.443 kilometers

Regarding the number of vehicles the company provides for mass transportation service, Shanghai again heads the list.

Cities and Companies		Rolling Stocks
Shanghai :		
The Electric Construction Co. ..	..	107 motored tramcars, 107 trailers, 99 railless trolley cars.
The China General Omnibus Co. ..	..	168 single-decked buses, 24 double-decked buses
Tientsin :		
Compagnie de Tramways et d'Eclairage de Tientsin	..	70 motored tramcars, 60 trailers.
Peiping :		
The Electric Tramway Co., Ltd. ..	..	65 motored tramcars, 31 trailers.

Below is the car-miles run and earnings per car-mile of the tramway Companies of the three cities during the year of 1935 :—

City	Car-miles run	Earnings per car-mile
Shanghai	10,627,132	28.25 cts.
Tientsin	3,637,000	36.44 cts.
Peiping	3,112,000	35.12 cts.

The riding habit of these three cities is listed below together with the population in 1935 for ready reference :—

City	Population	Riding habit
Shanghai	3,529,120	43.2
Tientsin	1,348,905	47.6
Peiping	1,564,869	12.8

The riding habit of the Shanghai population will certainly top the list if the traffic in the French Concession and in the Chinese municipal areas are included.

The ever increasing demand for motor buses in large cities has proved that the omnibus is one of the most suitable vehicles for mass transportation service in large municipalities. It has been developed from two salient factors. One is the successful development of automobile engines and the other is the better method and suitable material for the paving of road surface which makes the rubber tyred vehicles best suited for mass transportation service on city streets.

Railless trolley cars have been becoming prominent for mass transportation service in large cities during recent years. It is highly desirable to promote the adaptation of railless trolley cars where coal is much cheaper and gasoline is more expensive.

In a country like China it is strictly undesirable to encourage the adoption of motor buses for city or interurban service, for the use of imported gasoline as motor fuel will be a great handicap during any international crisis. On the other hand, railless trolley bus should be promoted for adaptation for both city and interurban service. When and where buses are adaptable for a given road surface, it should not be difficult to replace the motor bus by a railless trolley bus on the same road.

Transportation engineers as well as bus company executives should not look upon the first cost as the sole determining factor in choosing equipment for mass transportation service. Consideration should be given to the item of operating expense and furthermore the great danger when much of the imported gasoline is consumed, steadily running down of the wealth of a nation.

In conclusion, China can no longer be considered as a backward country, time should be allowed for her in the adoption of modern civilization.

Engineering Development in China

(Continued from page 50)

The rim of the sun of science has appeared over the horizon in China. The old dragons are shrinking back into their caves, for they cannot survive in the new sunlight. Progress is now planted firmly upon machinery, upon steam and internal combustion engines, the dynamo, the printing press, radio and all manner of mechanical contrivances. It will suffer no serious check. China has commenced the latest and greatest intellectual and material transformation in the 40 centuries of her wonderful history.

Priceless inventions of comparatively recent origin have bred in many countries a larger humanity and loftier aims. In some parts of the world they have already served to reduce drudgery to make labor noble, to break down barriers between nations, to extinguish racial hatreds, to bring together, in conscious solidarity, all the peoples of all lands. If these great gifts to humanity are prostituted by ambitious politicians, or the parasites who craftily deceive simple-minded workers, you should not blame engineers. A surgeon's knife is designed to save life, but it has been used to cut a man's throat.

Need for Engineering Propaganda

The word "propaganda" has obtained an unsavoury reputation because of its association with international intrigues. But there is a great need for propaganda on behalf of engineering development in China, not only in China itself, but in those countries that can supply the advice, the finance and the machinery needed. Each one of you can help to make known to your friends the opportunities for profitable and humanitarian work in the Far East.

I am told that in the Chinese script the same word stands both for "publicity" and "justice." If so, engineering applications will finally conquer corruption, famines, floods and poverty.

Not to the corrupt officials, the War Lords and the bandits, who have reddened China's recent history, shall our praises go ; but to the great mass of the people who have toiled with cheerfulness and industry in their daily tasks. Chinese engineers and arti-

sans are leavening the mass, and working with great tenacity of purpose, for the future prosperity of their nation.

Perils previously unknown are, however, created by the increase in wealth that comes from the application of science to industry. The youth of China cannot expect their nation to be respected if they are self-indulgent and inefficient. I can give my testimony, the experience of nearly 25 years, with a fairly close association with Chinese artisans and engineering students. As far as I can remember, I have never had, in all that time, a wry word or anything but respect and consideration and good work from a Chinese workman in our shops, or polite treatment from a Chinese student.

The national characteristics include great industry and considerable ingenuity. With the same training and opportunities, Chinese engineers and artisans are as capable as any other nationals in carrying out technical designs and engineering works. If there is loyal co-operation with foreigners, increased facilities for training artisans, and peace in the land, Chinese engineers will have a wonderful opportunity to benefit their nation and to add to the wealth and security of other peoples. It is my fervent hope that I may live to see the great transformation of China which I know is possible and which at some time is inevitable.

"A Sea That Salts"

There is a Chinese saying : "China is a sea that salts all of the rivers that flow into it." In common with others of my countrymen who have spent many years amongst the Chinese, I have found much to admire and much to make me sanguine of the future of China as a result of my experience. It is my sincere hope that encouragement will be given by all of you to those Chinese who are working to develop the natural resources of their country.

That is the only method of raising this peace-loving people to a powerful position amongst the nations of the earth. I am sanguine that not only will they increase the total material wealth of mankind, but they will also produce many scientific researches of great value to the rest of humanity. Those are my reasons for begging you to encourage engineering work in China.

Electrification of the Lun Chong Cotton Mill

The China Printing and Finishing Company's New Spinning and Weaving Mill Supplied with the Latest Equipment by the General Electric Company

By N. G. BEALE, General Manager of the General Electric Company of China

ONE of the largest textile undertakings in the Far East is The China Printing and Finishing Co., Ltd. This company has been established in China for a number of years, possessing several extensive factories and carrying on an important business as bleachers, dyers, printers and finishers of cotton piece goods. A further large factory has recently been added to the existing group for the manufacture of grey cotton cloth, so that the company now produces finished goods in the form of bleached, dyed and printed fabrics from the raw cotton. The finished goods are marketed throughout China by the company's selling organization which is directed from its Head Office in Shanghai.

The new factory comprises a cotton spinning and weaving mill known as the Lun Chong Cotton Mill, and is situated on the Pootung bank of the Whangpoo River at a point opposite the International Settlement at Shanghai. The total area of the new mill is approximately 75,000 sq. yards. It employs over 2,000 people, mostly Chinese, and in it are installed approximately 1,150 looms and 50,000 spindles.

The building itself and the equipment installed represent the very latest in modern practice. The comprehensive contract for the electrification of the mill, involving a complete power station with boiler plant, water filtration plant, turbo-alternators and switchgear, together with motors totalling 214 in number and 2,500 h.p. in capacity, control gear, distribution boards, cables, wiring, electric light fittings and lamps, was awarded to The General Electric Co. of China, Ltd.

A brief description of the new mill and the processes involved in the production of grey cotton cloth, with particular reference to the electrical plant, is given in the following article.

Power Station Equipment

The power station, Fig. 1, is a reinforced concrete structure of unusual design, the architects being Davies, Brooke & Gran of Shanghai. It is situated approximately 400 yards from the river bank, with plenty of space for future extensions, if required. The location of the power station with respect to the mills is such that the voltage drop along the distribution lines and the length of steam piping required for conducting heating steam to the slashing and sizing departments, are reduced to a minimum.

Boiler Plant

The boiler plant comprises three Babcock & Wilcox water tube boilers, each provided with two 42-in. dia. steam and water drums and having a heating surface of 3,580 sq. ft. Each boiler is capable of producing 15,000 lb. of steam per hour, as a normal load, at a pressure of 275 lb. per sq. in. Integral type superheaters are installed to raise the temperature of the steam to 650°F. at the superheater outlet. Mechanical chain grate stokers,

having a grate area of 98 sq. ft. and provided with unit driving gear and operating motor, are installed with each boiler.

A cast iron vertical tube economizer with scrapers, driving gear and motor is provided; also a motor driven induced draught fan with the necessary dampers. The driving motor is rated at 45 h.p., 360 r.p.m., and is of the pipe ventilated squirrel cage type, controlled by an oil immersed star-delta starter.

Two vertical direct-acting boiler feed pumps, each capable of feeding two boilers are installed. The exhaust steam from these pumps is taken through a coil in the hotwell so that the heat in the steam may be utilized for raising the temperature of the boiler feed water.

In order to provide heating and process steam for the mill, which is required at a pressure of 60-80 lb. per sq. in. and a temperature not exceeding 400°F., a pressure reducing valve and a desuperheater are installed. As the heating steam is only required for two or three months in the year, it was not considered advisable to extract this from the turbine. The condensed steam from the heating system is collected and pumped back to the hotwell. This condensate pump is driven by a 5 h.p. motor controlled by a contactor starter operated by a float switch. For the make-up boiler feed, water from the Whangpoo River, which contains a considerable quantity of mud in suspension, is taken from the condenser cooling water system, and delivered to a gravity settling tank. Thence it is pumped through pressure type filters to a Lassen-Hjort water softener and then delivered to the hotwell tank. Duplicate motor driven pumps and filters are installed, each having a capacity of 400 gallons per hour, and are controlled by a float switch operating contactor starters.

An alternative supply of make-up water is available from an overhead tank, supplied from a deep well. The water from the deep well is raised by compressed air, two air compressors driven by 10 h.p. motors being employed for this purpose.

Power Plant

The power station is equipped with two 380-volt, three phase, 50-cycle turbo-alternators, one of 2,000 kw. capacity (2,500 kva at 0.8 p.f.) and the other of 100 kw. (125 kva at 0.8 p.f.), provision being made for two further 2,000 kw. sets,

one of which is at present in course of construction at Witton Engineering Works. The 2,000 kw. set as illustrated in Fig. 2, is of the combined type, in which the bottom half of the turbine exhaust casing and the condenser shell form one casting, thus reducing the dimensions of the foundations to a minimum and eliminating the usual condenser basement. The turbine, which is of the high pressure, multi-stage impulse type, runs at a speed of 6,000 r.p.m., and drives the alternator through totally enclosed helical gears to reduce the speed to 1,000 r.p.m.

The alternator is of the enclosed revolving

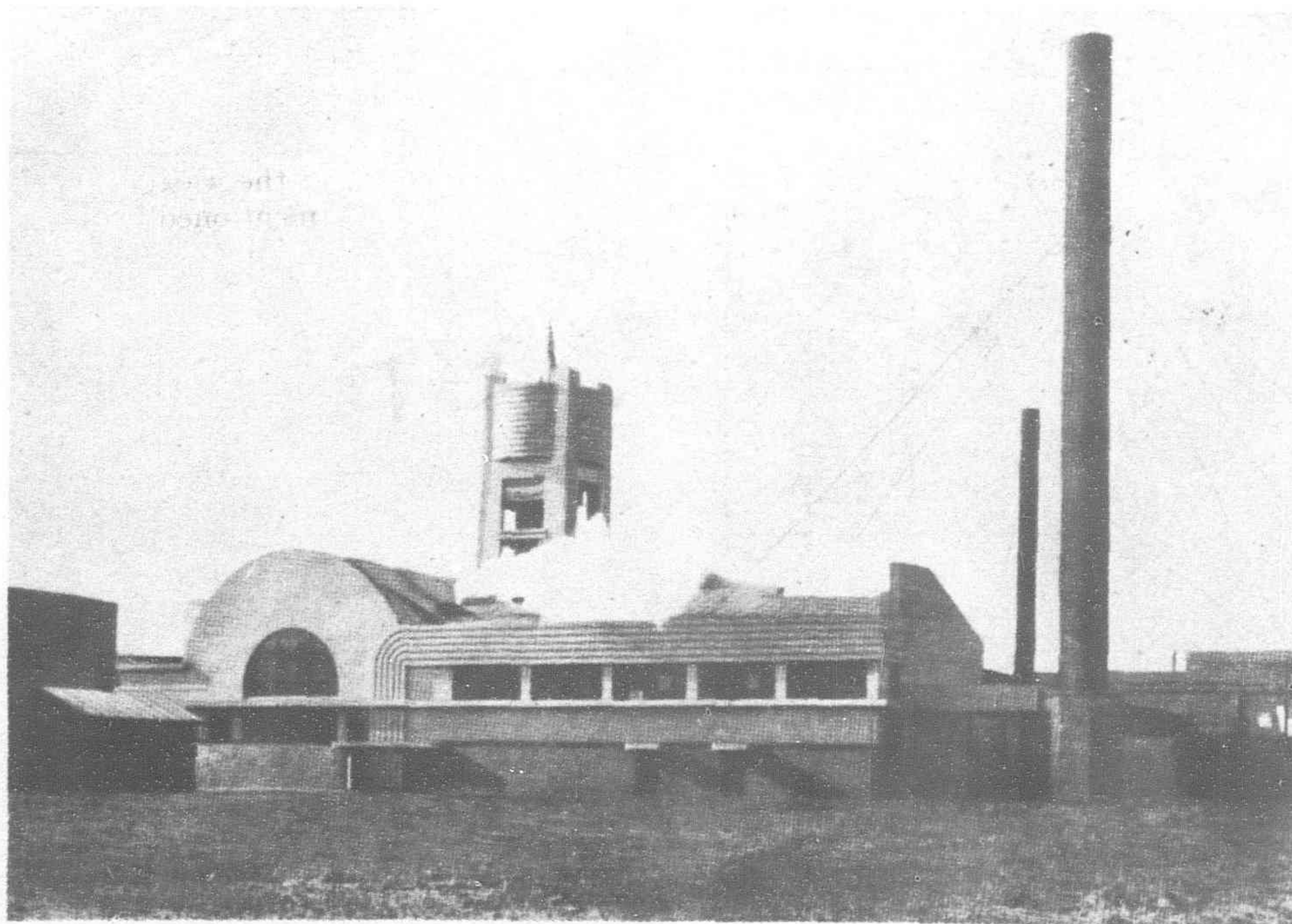


Fig. 1.—The power station of the Lun Chong Cotton Mill, China

field salient pole-type, having a direct coupled exciter which is provided with inter-poles to ensure sparkless running at all loads with fixed brush position.

A rheostat, mounted on the switchboard is inserted in the shunt field circuit of the exciter, and is capable of regulating under all conditions of load and power factor.

A surface type condenser is installed and is provided with a $4\frac{1}{2}$ h.p. vertical motor driven condensate extraction pump and a steam-operated air ejector of the two stage type with a combined feed water heater. Cooling water for the condenser is provided by circulating water pumps, located in the pump house on the river bank. Two pumps are installed, one acting as standby. They are driven by 75 h.p. vertical slip ring motors which are provided with contactor control panels, Fig. 3, remote controlled from the turbine room.

The 100 kw. turbo set, Fig. 4, which is used when the main 2,000 kw. set is shut down, is of the high pressure impulse, back pressure type, running at a speed of 7,000 r.p.m. Totally enclosed helical gearing is provided to give an alternator speed of 1,500 r.p.m. The alternator is of the protected, revolving armature type, having an interpole type exciter, driven through a flexible coupling. As in the case of the 2,000 kw. set, the exciter shunt field rheostat is mounted at the back of the switchboard.

Main Switchboard

The main 380-volt flat back switchboard, Fig. 2, is situated in the power station, and of the eleven panels comprising this board the first consists of a Brown Boveri automatic voltage regulator, while the second controls a 2,000 kw. alternator. Owing to the heavy currents which have to be controlled, amounting to 2,800 amperes per phase, this panel is built in two sections.

On one section are mounted a 2,000 ampere, triple pole hand operated oil circuit breaker, fitted with three overload trip coils, and three 2,000 ampere single pole isolating links. On the other section is mounted similar equipment with the addition of a 200 ampere field switch, exciter regulator with handwheel and chain drive, time limit fuses, instrument

fuses, current transformers, ammeters, voltmeter, etc. The two oil circuit breakers are connected in parallel and provided with the necessary interlocks.

The remaining panels control the 100 kw. alternator, feeders to the mill, power station auxiliaries and lighting.

A swing panel equipped with a rotary synchroscope with lamps, and two sector pattern illuminated dial voltmeters, is hinged on the side of No. 1 panel of the main switchboard.

Processes in the Mill

A list of the motors and starters, with their respective duties, is given in Table 1. The use of these motors and starters will be understood better by following the process of the cotton through the various departments in the mill.

The bales of raw cotton are delivered from the raw cotton store to the opening and mixing room. The cotton is here fed to the hopper bale breaker and

thence through a series of opening and cleaning machines where the matted pressed cotton is opened and a proportion of the short fibre and dust content removed. This series of opening machines consists of the hopper feeders, Creighton openers, and horizontal openers, the first being shown in Fig. 5. The opened cotton is then conveyed pneumatically to a condenser. The roving waster opener is installed to treat a quantity of the waste made in the later processes.

The previously mentioned condenser feeds the cotton to the intake of a pneumatic trunk which in turn conveys it to the scutching room, where it is automatically distributed to the various batteries of machines for further cleaning. The machines consist of a hopper feeder giving a uniform and continuous supply of cotton to the scutcher where the cotton is struck by means of a quickly revolving beater and carried over a series of bars between which the short fibre, seed and sand, etc., are ejected. The good fibre is picked up by air current and carried to the surface of a pair of perforated rollers which deliver the cotton in the form of a sheet to the calender rollers. These rollers serve to consolidate the sheet into a form which enables the succeeding rollers to wind to into a roll formation, known as "lap," ready for the carding process.

Fig. 6 illustrates the scutchers, and it will be noted that the driving motors are of the totally enclosed cowl cooled type identical with those used for driving the ring spinning frames referred to later.

Cards

The carding process consists of removing any dirt which may still remain in the cotton, finally delivering it in a rope form suitable for the next process.

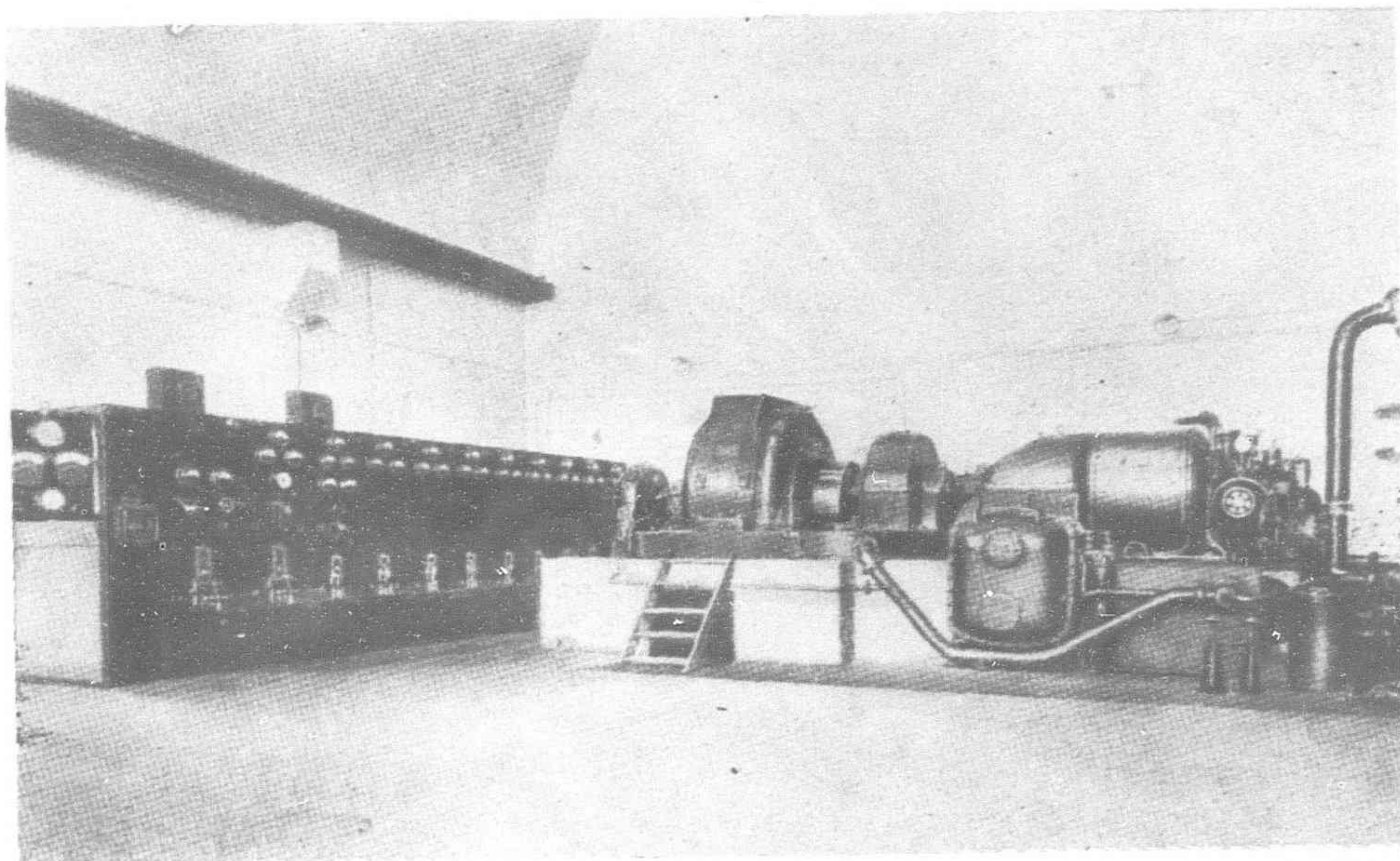


Fig. 2.—2,000 kw., 380-volt turbo-alternator which runs at a speed of 6,000/1,000 r.p.m., and main 380-volt switchboard installed in the power station

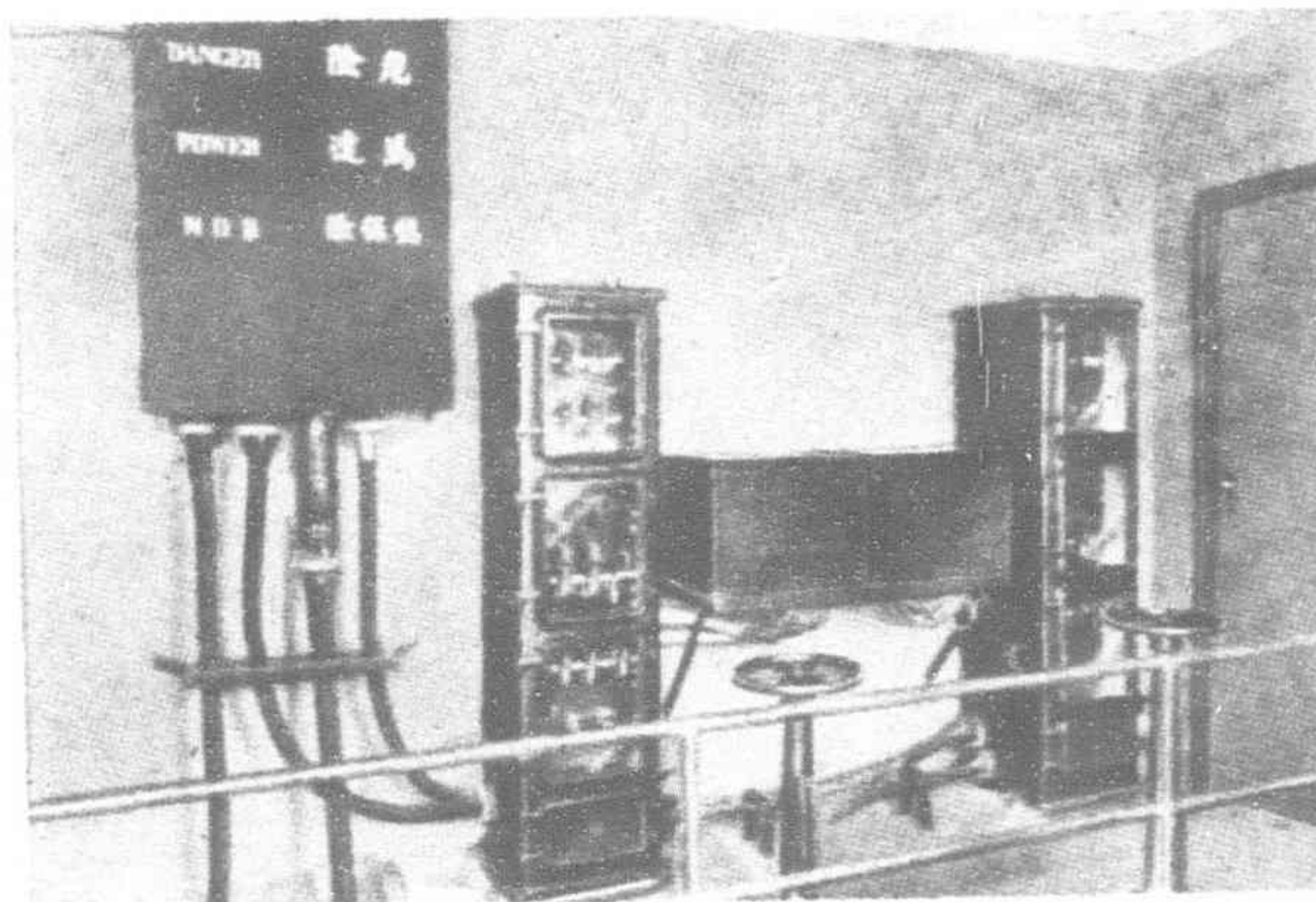


Fig. 3.—Contactor panels controlling 75 h.p. motors driving condenser cooling water pumps. On the left is seen the pump house distribution board

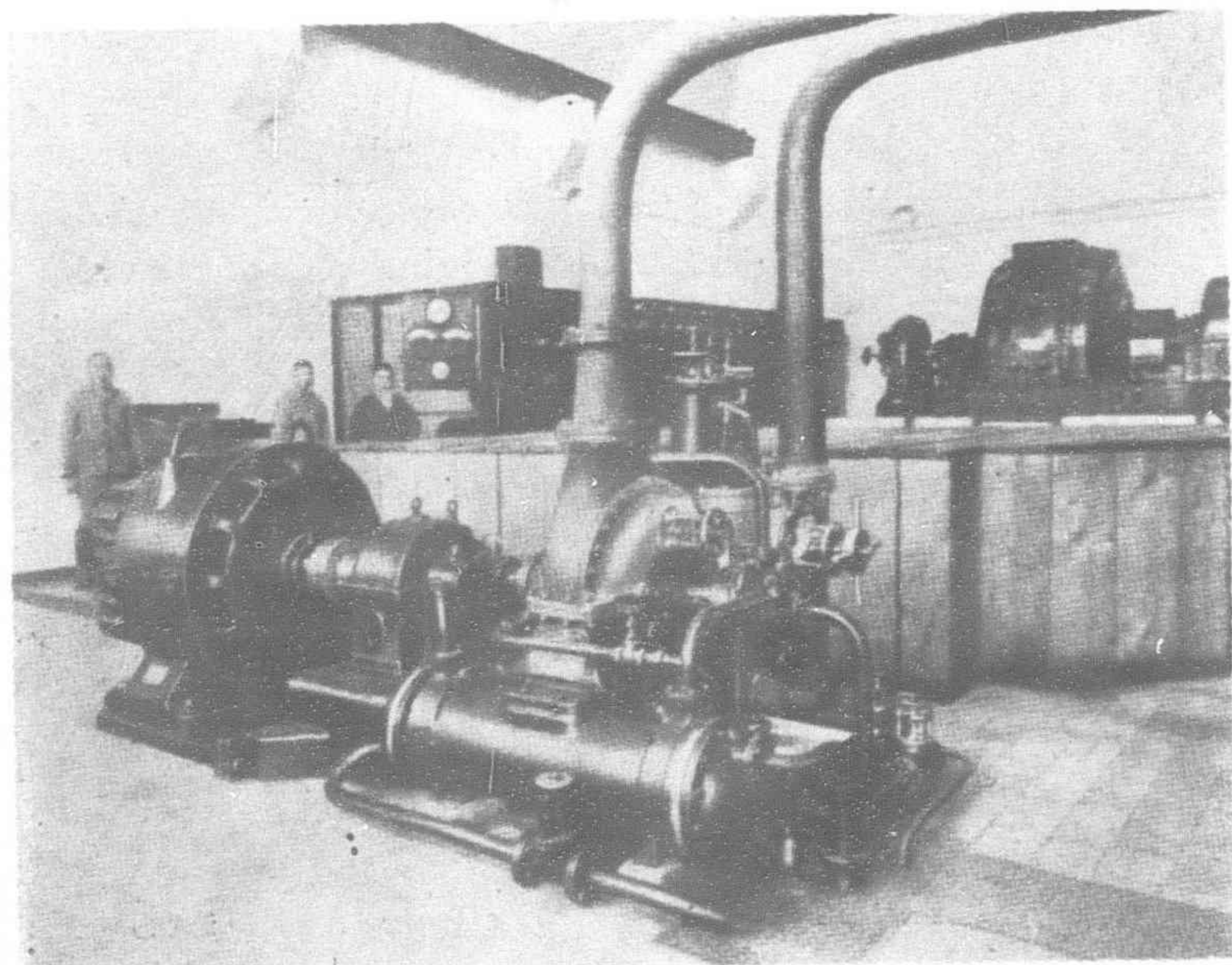


Fig. 4.—100 kw., 380-volt, back pressure geared turbo-alternator, which runs at a speed of 7,000/1,500 r.p.m., and is used when the main set is shut down

The "laps," as delivered from the scutchers, are placed on revolving rollers at the entering end of the cards. As these rollers revolve, the laps unwind and are led into the machine by means of fluted rollers, to a circular saw type roller, called the "ticker-in," the teeth of which comb through the lap and pick up small tufts of fibre and carry them over grids through which further impurities escape. The good fibre is in turn picked up by a cylinder covered with fine wire, and in its passage to the front of the machine is further cleaned and eventually delivered in the form of a fleece which is drawn together in

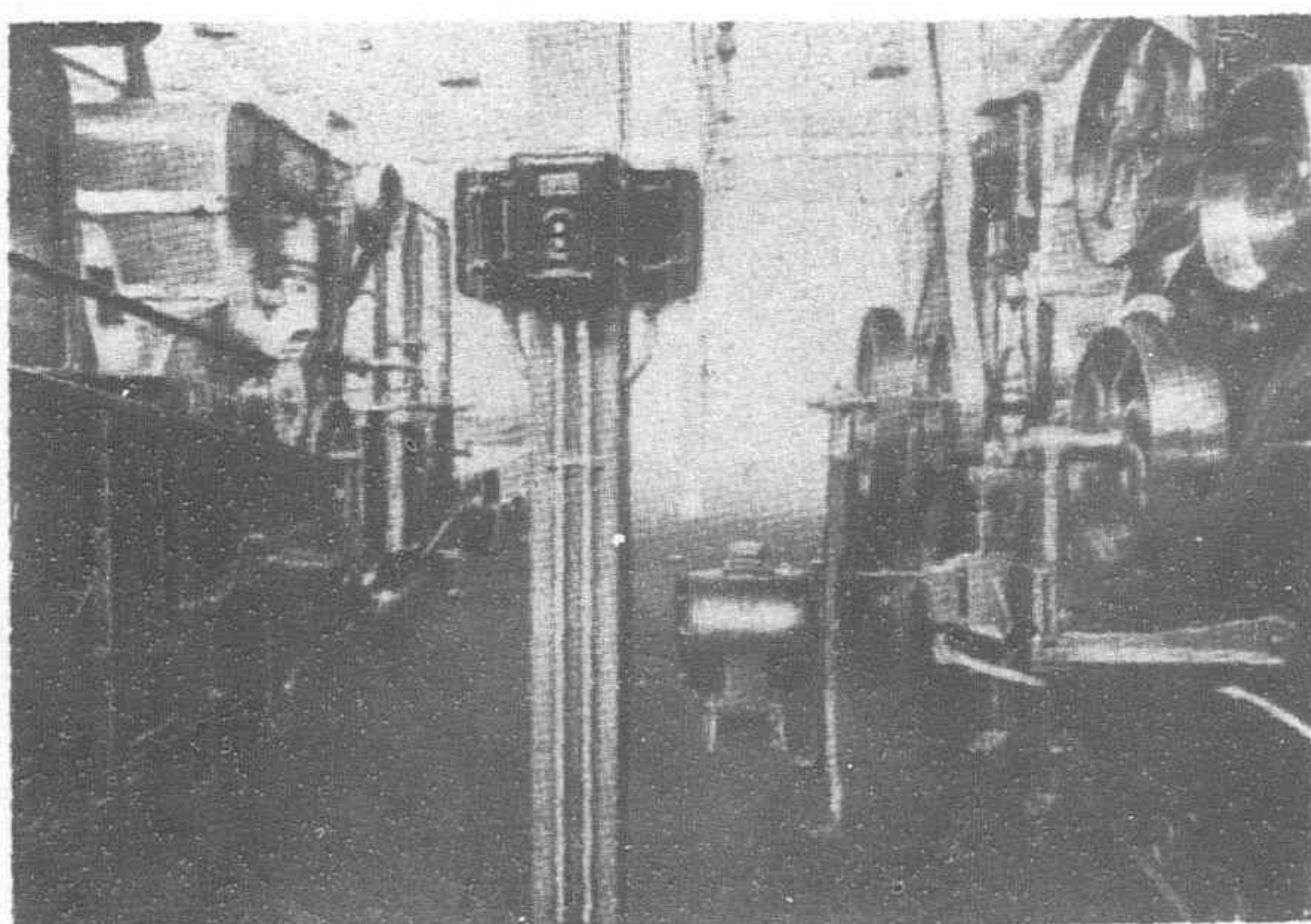


Fig. 5.—Hopper opener and feeder machines

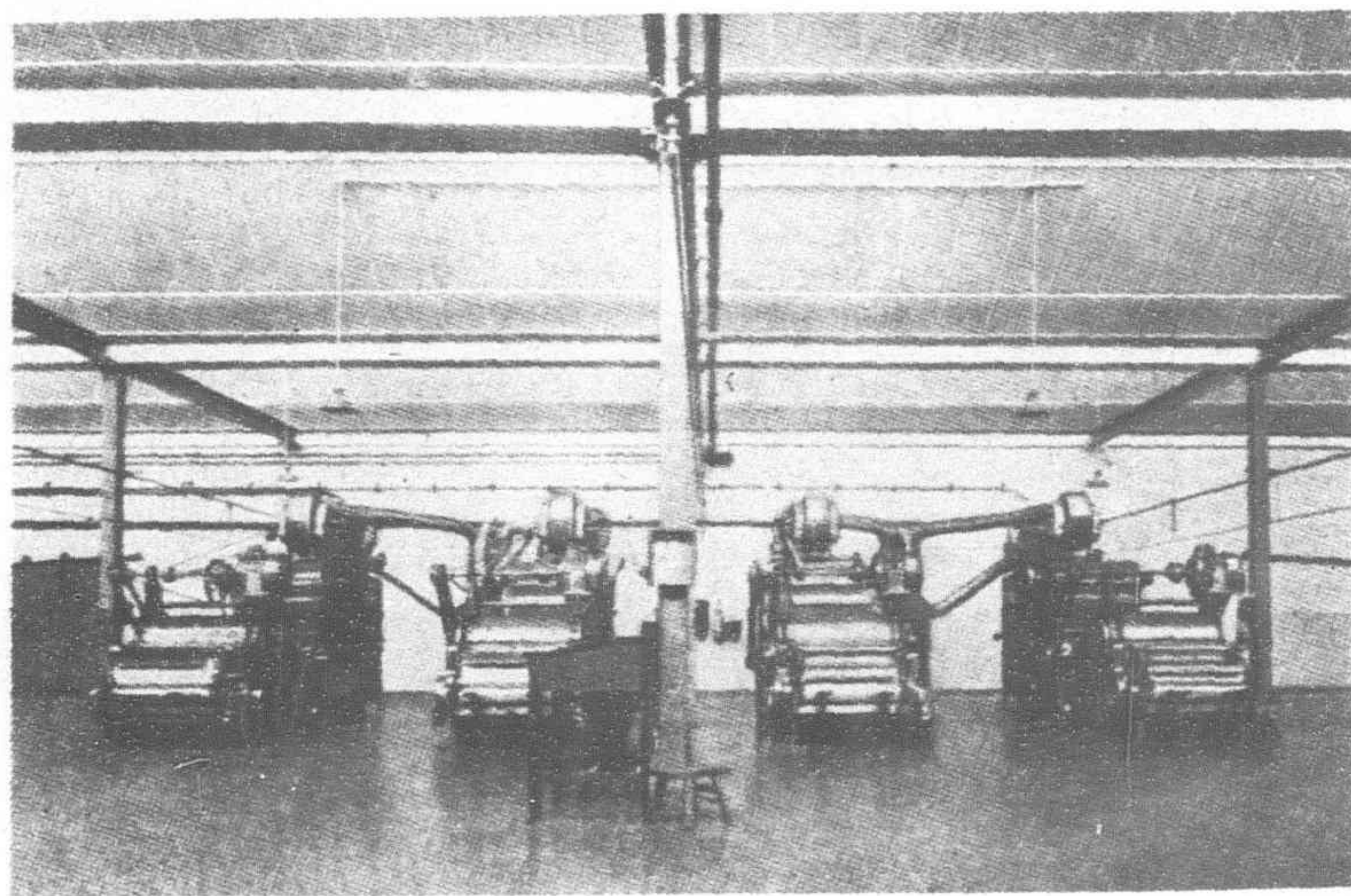


Fig. 6.—Scutchers used in the process of cotton cleaning

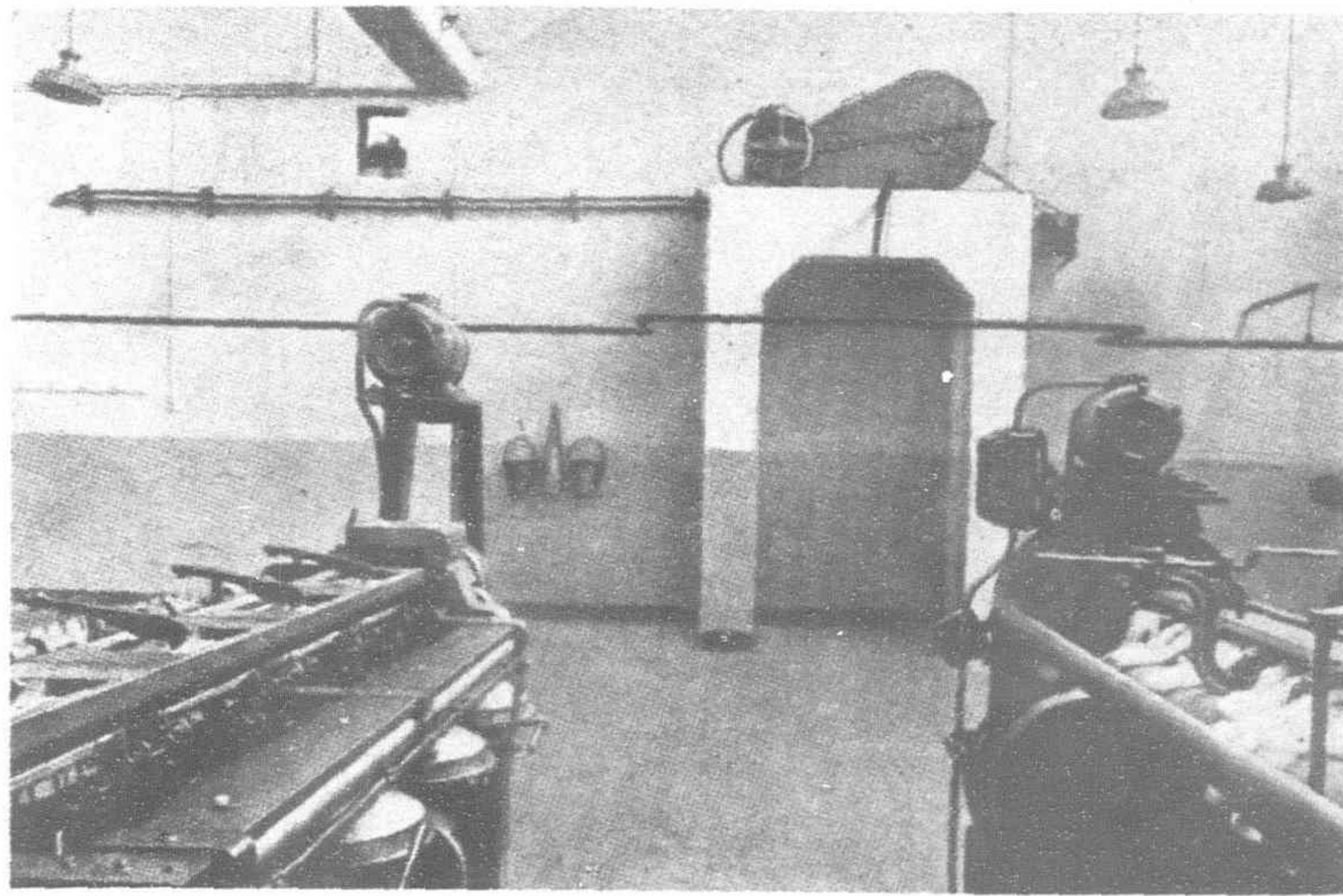


Fig. 7.—50 h.p., 975 r.p.m., high torque squirrel cage motor mounted on a structure against the wall, operating carding machines through chain drive. In the foreground are the sampling machines

TABLE 1

Drive	Number	H.P.	Speed	Type of Motor	Type of Starter
Hopper bale breakers and hopper openers ..	2	6	1440	S.C.T.E.	D.T.L. contactor
Creighton openers	4	2	940	S.C.T.E.	D.T.L. contactor
Hopper lattice feeders and condensers ..	2	6	1440	S.C.T.E.	D.T.L. contactor
Roving waste openers and condensers ..	3	4	1440	S.C.T.E.	D.T.L. contactor
Scutcher hopper feeders and condensers ..	4	9	1440	S.C.T.E.C.C.	D.T.L. contactor
Carding engines	3	50	975	S.C.H.T.E.V.	Oil immersed star/delta
Drawing frames	21	1½	1450	S.C.T.E.	D.T.L. contactor
Speed frames	2	50	975	S.C.H.T.E.V.	Oil immersed star/delta
Ring spinning frames	96	9	1440	S.C.T.E.C.C.	D.T.L. contactor
Ring doubling frames	10	12	1450	S.C.T.E.C.C.	D.T.L. contactor
Quick traverse winders	1	4	965	S.C.T.E.	D.T.L. contactor
Cone winding	10	2	1455	S.C.T.E.	D.T.L. contactor
Beam warping	4	1½	710	S.C.T.E.	D.T.L. contactor
Pirn winding	7	6	1440	S.C.T.E.	D.T.L. contactor
Card stripping	1	20	2900	S.C.E.V.	Oil immersed star/delta
Sizing	1	35	975	S.C.E.V.	Oil immersed star/delta
Looms	9	50	975	S.C.H.T.E.V.	Oil immersed star/delta
Mechanics shop	1	15	720	S.C.E.V.	Oil immersed star/delta
Humidifier	1	70	1470	S.C.H.T.E.V.	Oil immersed star/delta
Humidifier	1	55	1470	S.C.H.T.E.V.	Oil immersed star/delta
Plaiting machine	1	4	1460	S.C.T.E.	D.T.L. contactor
Sampling machines	5	1½	1460	S.C.T.E.	D.T.L. contactor
Joiner's shop	1	15	720	S.C.E.V.	Oil immersed star/delta
Roller covering	1	12	1450	S.C.T.E.C.C.	D.T.L. contactor
Bracket screen, driving	1	10	720	S.C.T.E.	Air break star/delta
Bracket screen washwater pump	1	4	960	S.C.E.V.	D.T.L. contactor
Condenser circulating water pumps	2	75	1450	Vert. S.R. Protected.	Remote controlled contactor with rotor resistances
Boiler induced draught fan	1	45	360	S.C.P.V.	Oil immersed star/delta
Boiler economizer	1	2	1410	S.C.E.V.	3 pole ironclad with fuses
Boiler chain grate stokers	3	1½	1410	S.C.T.E.	3 pole ironclad with fuses
Make-up feed booster pumps	2	1	1410	S.C.E.V.	D.T.L. contactor with float switch
Deep well air compressors	2	10	960	S.C.E.V.	D.T.L. contactor
Condensate extraction pump (turbo set) ..	1	4½	1440	Vert. S.C. Protected.	D.T.L. contactor
Condensate pump (heating system)	1	5	960	S.C.E.V.	D.T.L. contactor with float switch
Baling press hydraulic pump	1	15	970	S.C.E.V.	Air break star/delta
Creels	1	7½	950	S.C.E.V.	3 pole ironclad with fuses
Spare motors	11	1½-50	710-1445	—	—

KEY TO SYMBOLS

S.R. Slip Ring
S.C.T.E. Squirrel Cage Totally Enclosed

S.C.E.V. Squirrel Cage Enclosed Ventilated
S.C.P.V. Squirrel Cage Pipe Ventilated

S.C.H.T.E.V. Squirrel Cage High Torque Enclosed Ventilated
S.C.T.E.C.C. Squirrel Cage Totally Enclosed Cowl Cooled
D.T.L. Direct to Line



Fig. 8.—Drawing frames driven by $1\frac{1}{2}$ h.p., 1,450 r.p.m. squirrel cage motors

Drawing Frames

The cotton, which leaves the carding machines in the form of a rope or sliver, is now passed through the drawing frames, with the object of making the sliver more regular per unit length and of bringing the fibres into a parallel position with respect to each other. These frames are separately driven by $1\frac{1}{2}$ h.p. motors through a V-belt drive, as shown in fig. 8.

Speed Frames

The sliver from the drawing frames requires to be further drawn out and made more regular before it is in a suitable form for spinning into yarn. The machines used for this process are slubbing frames, intermediate frames and roving frames. These machines are arranged side by side in the correct sequence, and are belt driven from

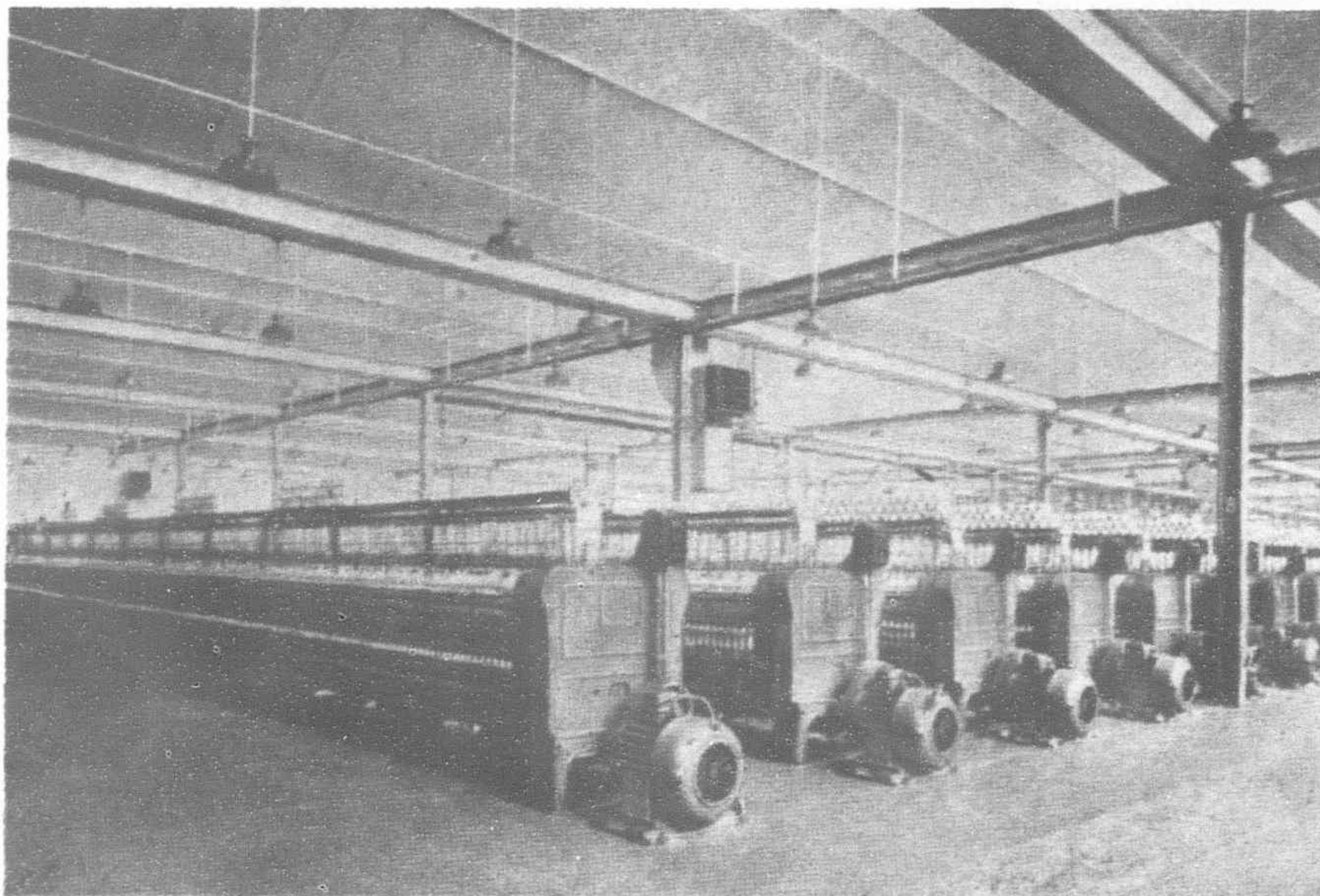


Fig. 10.—Another view of the ring spinning frames

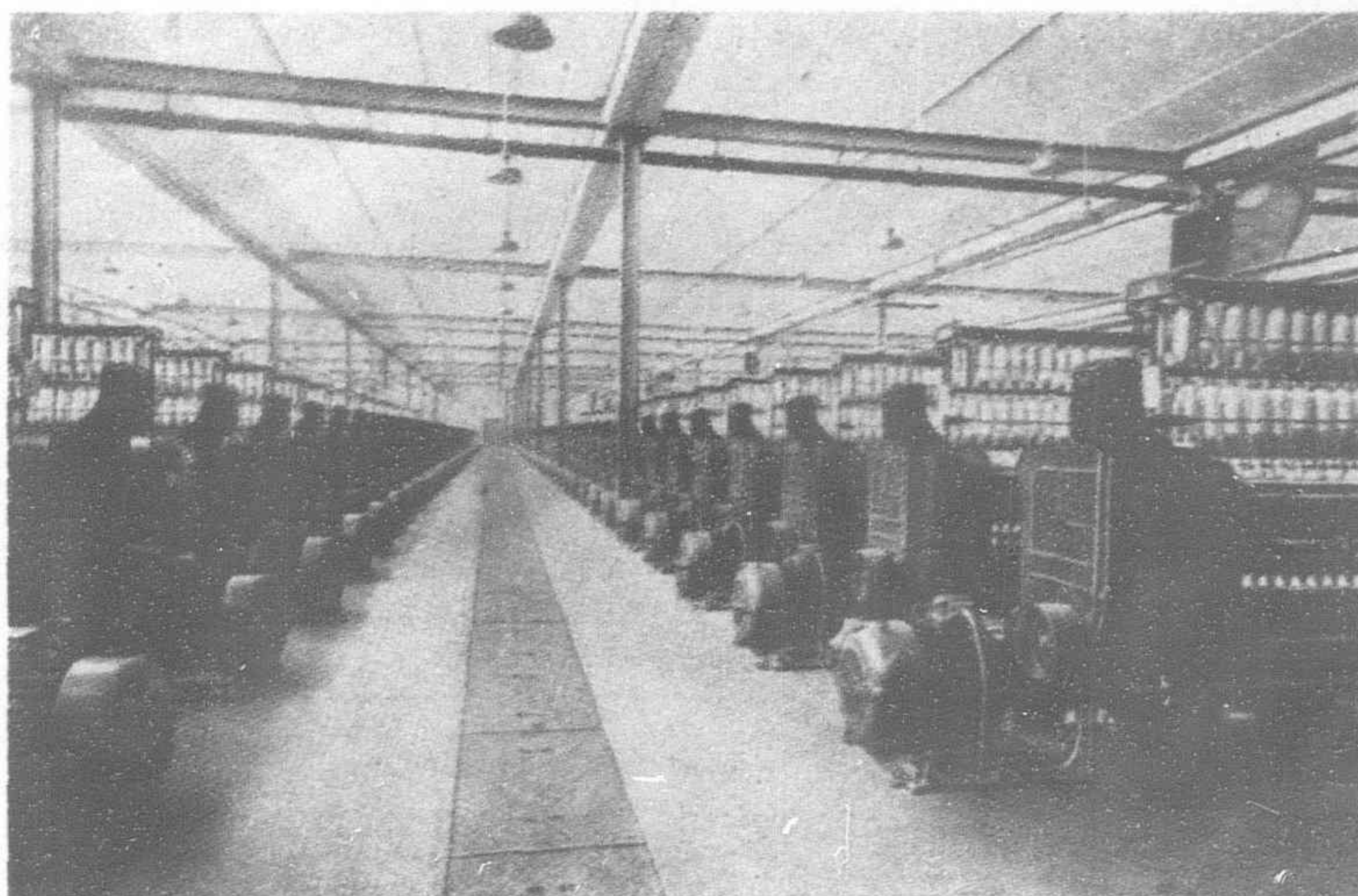


Fig. 9.—Ring spinning frames driven by a total of 96 9 h.p., 1,440 r.p.m. squirrel cage cowl cooled motors. The trench along the center of the gangway accommodates bare copper bus-bars

two overhead line shafts, each driven by a 50 h.p. 975 r.p.m. high torque squirrel cage motor through chain drives. As in the case of the carding machines the motors and chain drives are mounted on platforms located in adjacent corridors, and their oil immersed star/delta starters are placed in convenient positions for operating from the floor.

Spinning Frames

The method of spinning adopted is known as ring spinning, and the process consists of drafting out the roving from the previous process, and imparting a twist to give the yarn the necessary strength.

The spinning frames are separately driven through V-belts by 9 h.p. totally enclosed cowl cooled motors. It is of interest to note that experiments were conducted in order to produce a motor capable of giving the necessary gradual starting characteristics to

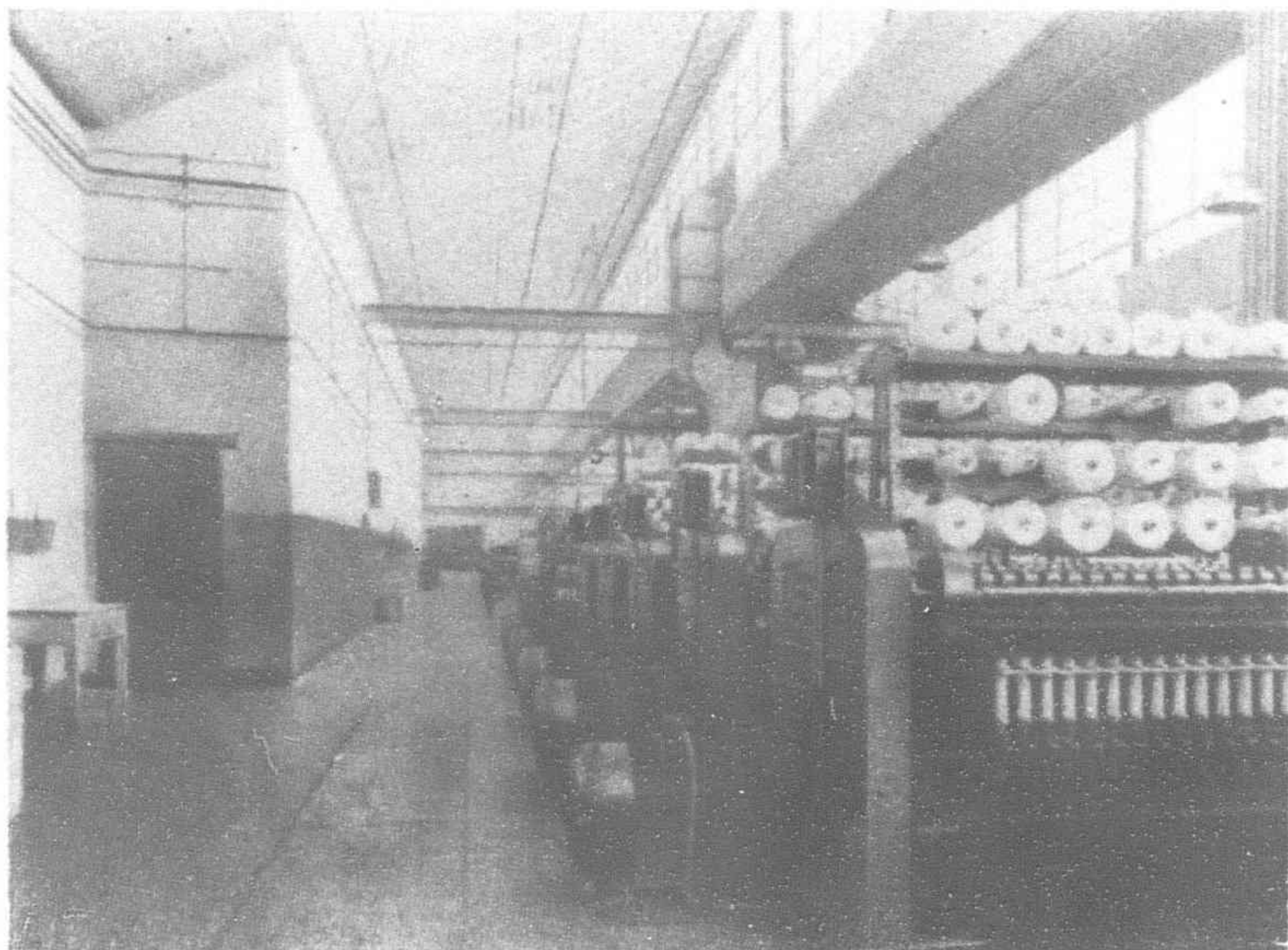


Fig. 11.—12 h.p., 1,450 r.p.m. squirrel cage cowl cooled motors driving ring doubling frames

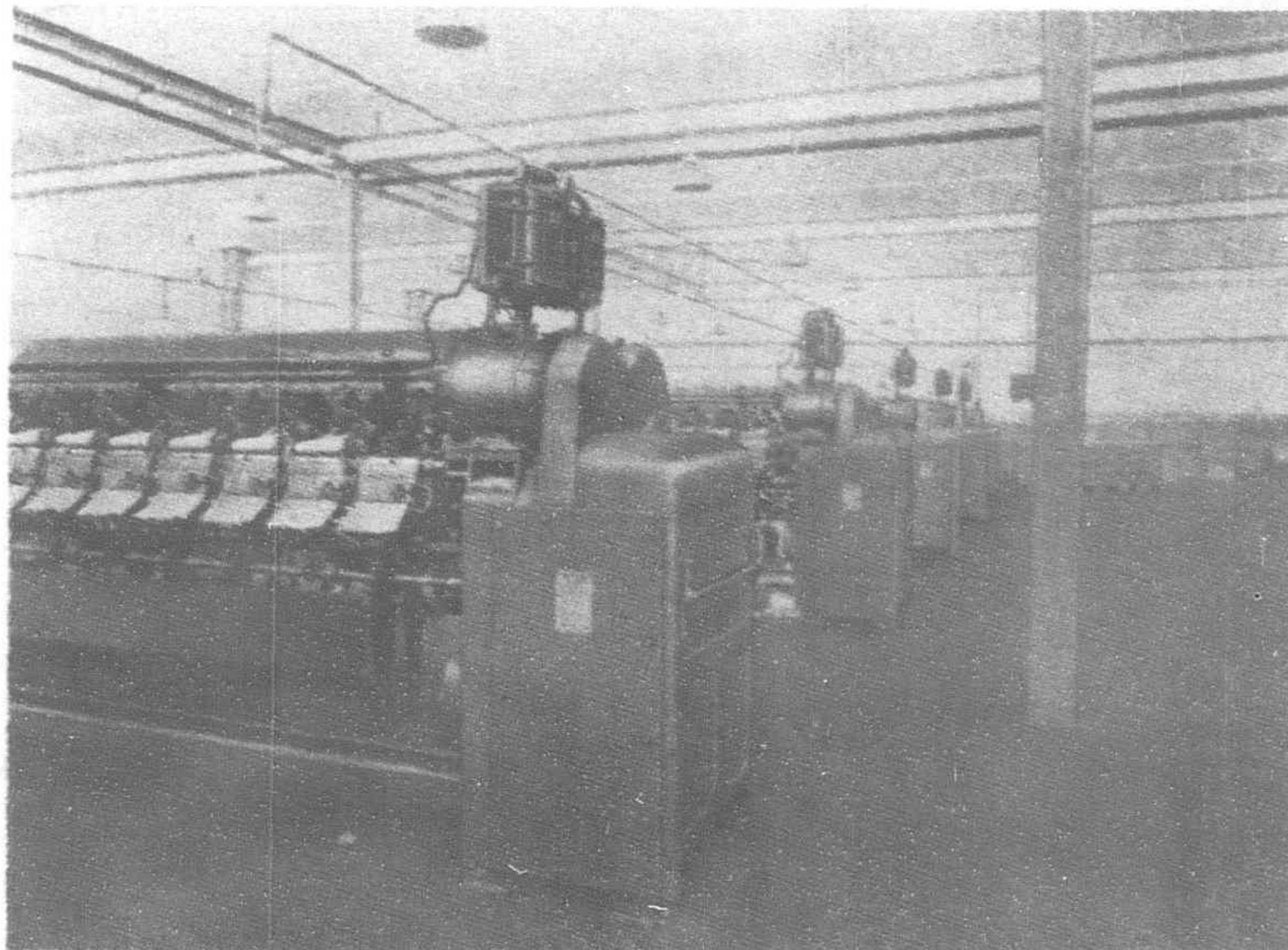


Fig. 12.—Double sided cone winders driven by 2 h.p., 1,455 r.p.m. squirrel cage motors

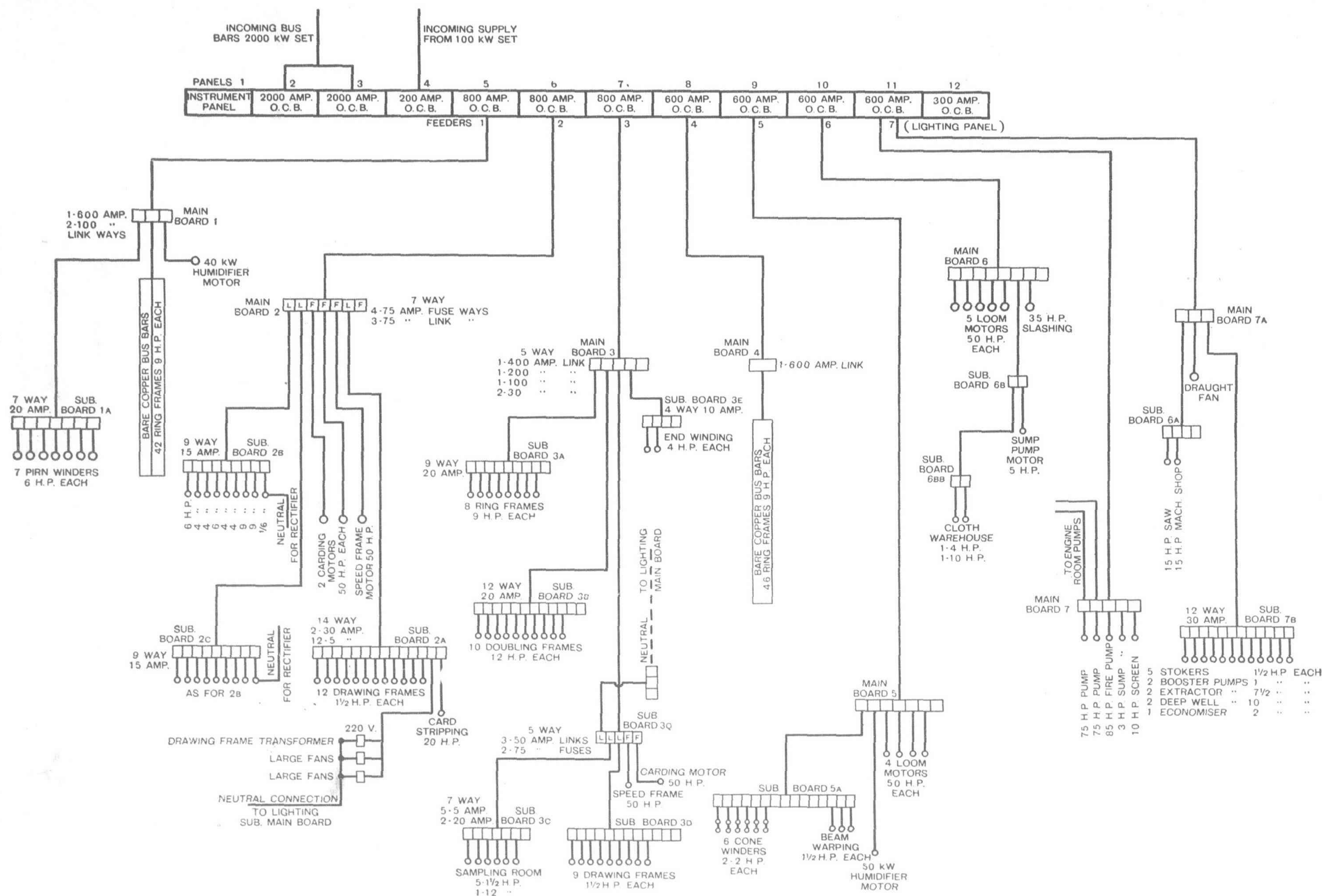


Fig. 13.—Single line diagram of the distribution scheme at the Lun Chong Cotton Mill

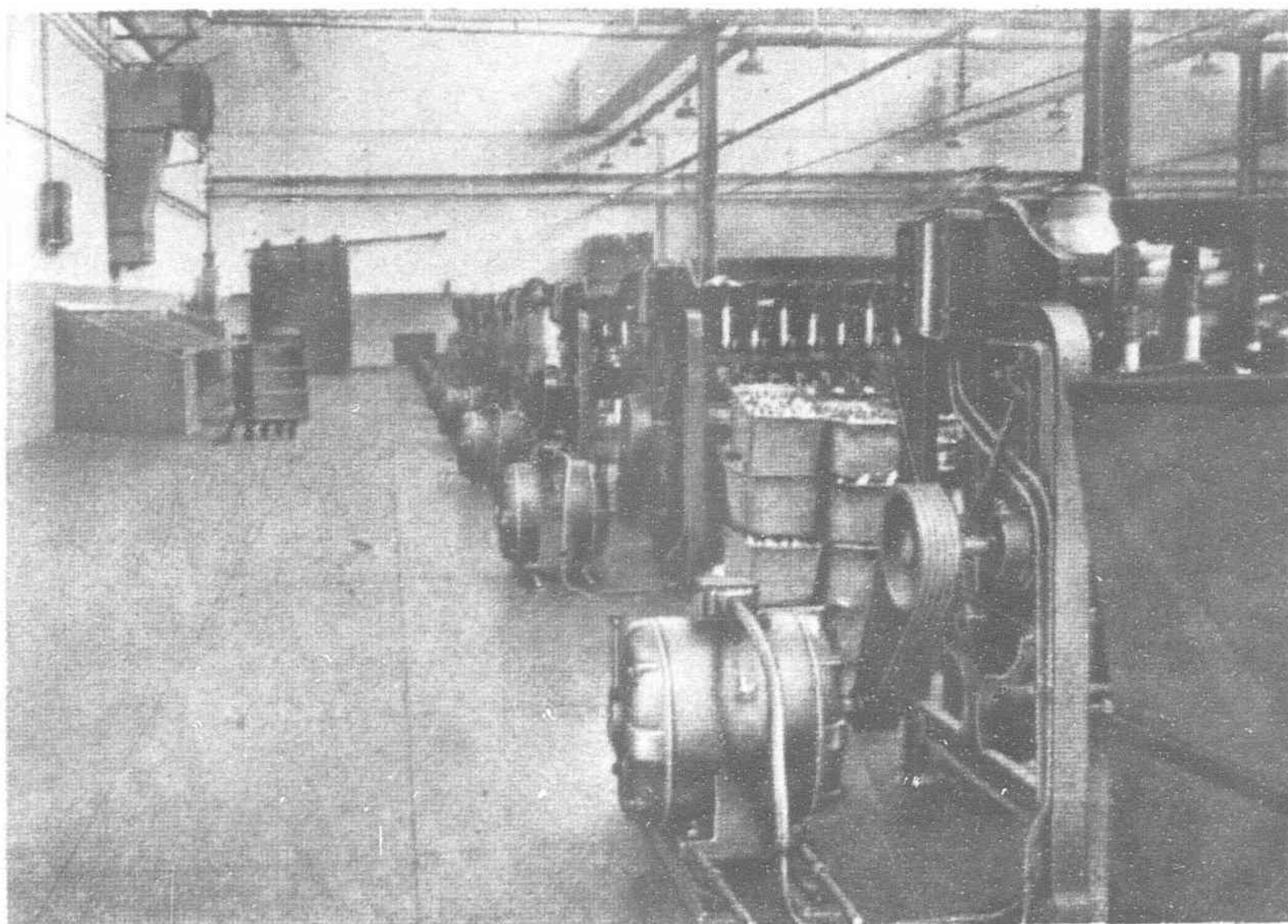


Fig. 14.—Pirn winding machines driven by 6 h.p., 1,440 r.p.m. squirrel cage totally enclosed motors

prevent the cotton breaking. These experiments resulted in a design of motor which has proved to be most successful in operation. The motors, together with their respective starters, are shown in Figs. 9 and 10.

Cheese Winders

Cheese winders are installed for assembling the threads in a form suitable for the doubling frames and are direct driven by 4 h.p. squirrel cage motors.

Ring Doubling Frames

Dry process doubling is adopted. As the name implies, the function of a ring doubling frame is to double the threads together to produce an elastic and smooth yarn. Ten of these machines are installed and are separately driven by 12 h.p. totally enclosed cowl cooled motors through V-belts. The motors with their respective starters are shown in Fig. 11.

Cone Winders

Cone winders are employed solely for the purpose of rewinding the cotton

from the doubling frame bobbins into a larger cone shaped formation ready for the beam warping machine. The winders are two sided, each side being driven by a 2 h.p. totally enclosed motor with direct-to-line contactor starter, as illustrated in Fig. 12.

Beam Warping

The warp is wound by beam warping machines on to suitable beams ready for the slasher sizer. Some thousands of cotton ends are frequently wound on to one beam and a friction clutch automatically disengages the machine in the event of one of the ends breaking. These machines are separately driven by V-belts, the larger pulley being combined with a friction clutch, as indicated in Fig. 15.

Slasher Sizing

The slasher sizer impregnates the warp with suitable size to enable it to withstand the strain of weaving. The process consists of taking the threads of a number of beams over guide rollers through a trough of boiling size and then through further rollers which squeeze out any excess size and moisture. The threads are then dried by passing over steam-heated cylinders, and re-wound on to a weaver's beam at the

delivery end of the machine. Four of these slasher sizers are installed and are driven by belt from a line shafting which, in turn, is belt driven by a 35 h.p. squirrel cage motor mounted on the floor.

Size boiling and mixing becks, driven from a second line shaft, are installed to provide the necessary size for the slasher sizers.

Pirn Winders

A number of pirn winding machines are installed to wind the yarn or weft from the spinning frames on to suitably shaped pirns to fit the loom shuttles. These machines are separately belt driven by 6 h.p. totally enclosed motors, as shown in Fig. 14.

Weaving

Group drive has been adopted throughout for the looms. Nine 50 h.p. high torque squirrel cage motors driving two lines of shafting by chain are installed on platforms located in a corridor adjacent to the weaving shed. Two of these motors with chain drive are

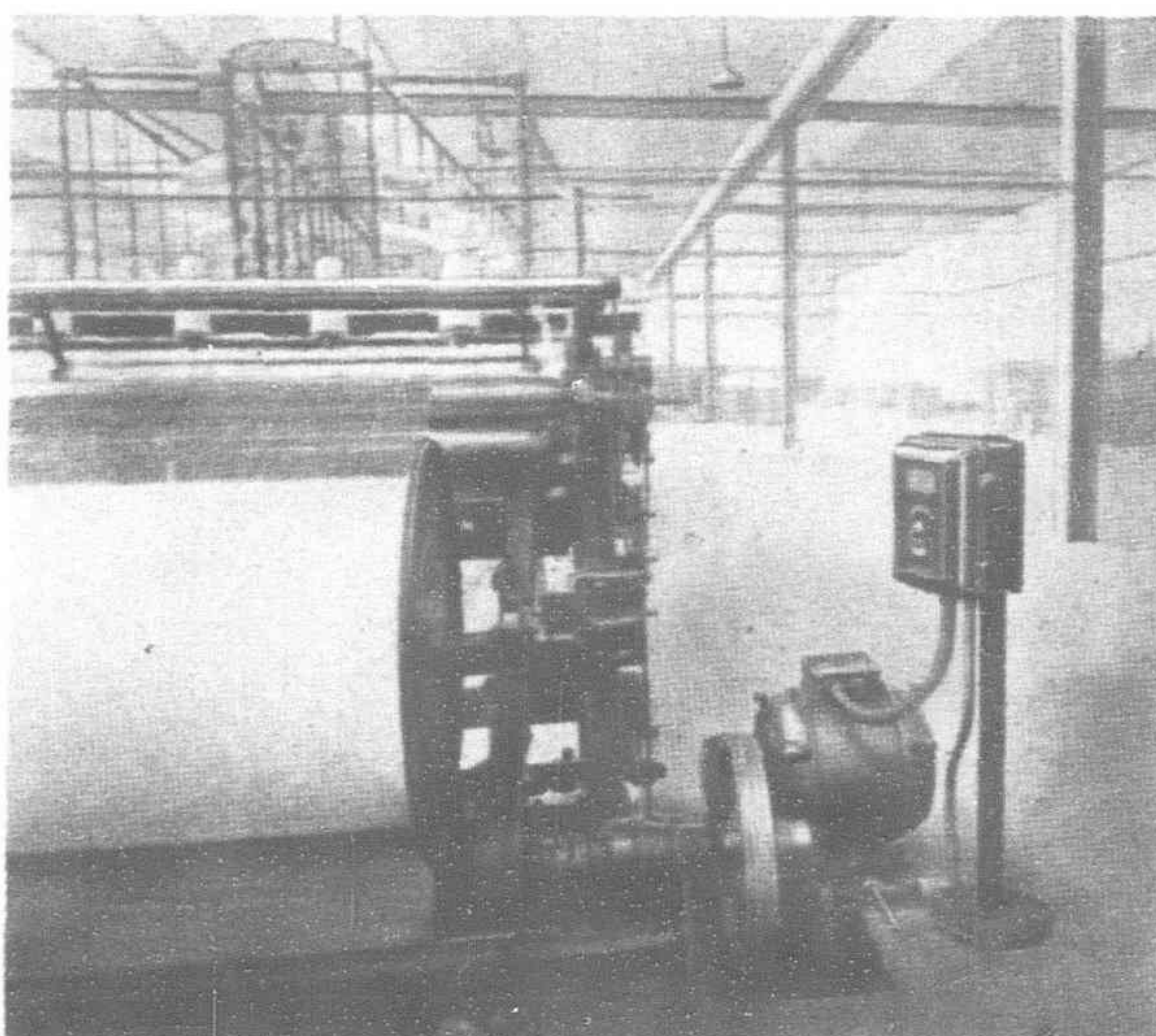


Fig. 15.—Beam warping machine driven by 1½ h.p., 710 r.p.m. squirrel cage totally enclosed motor

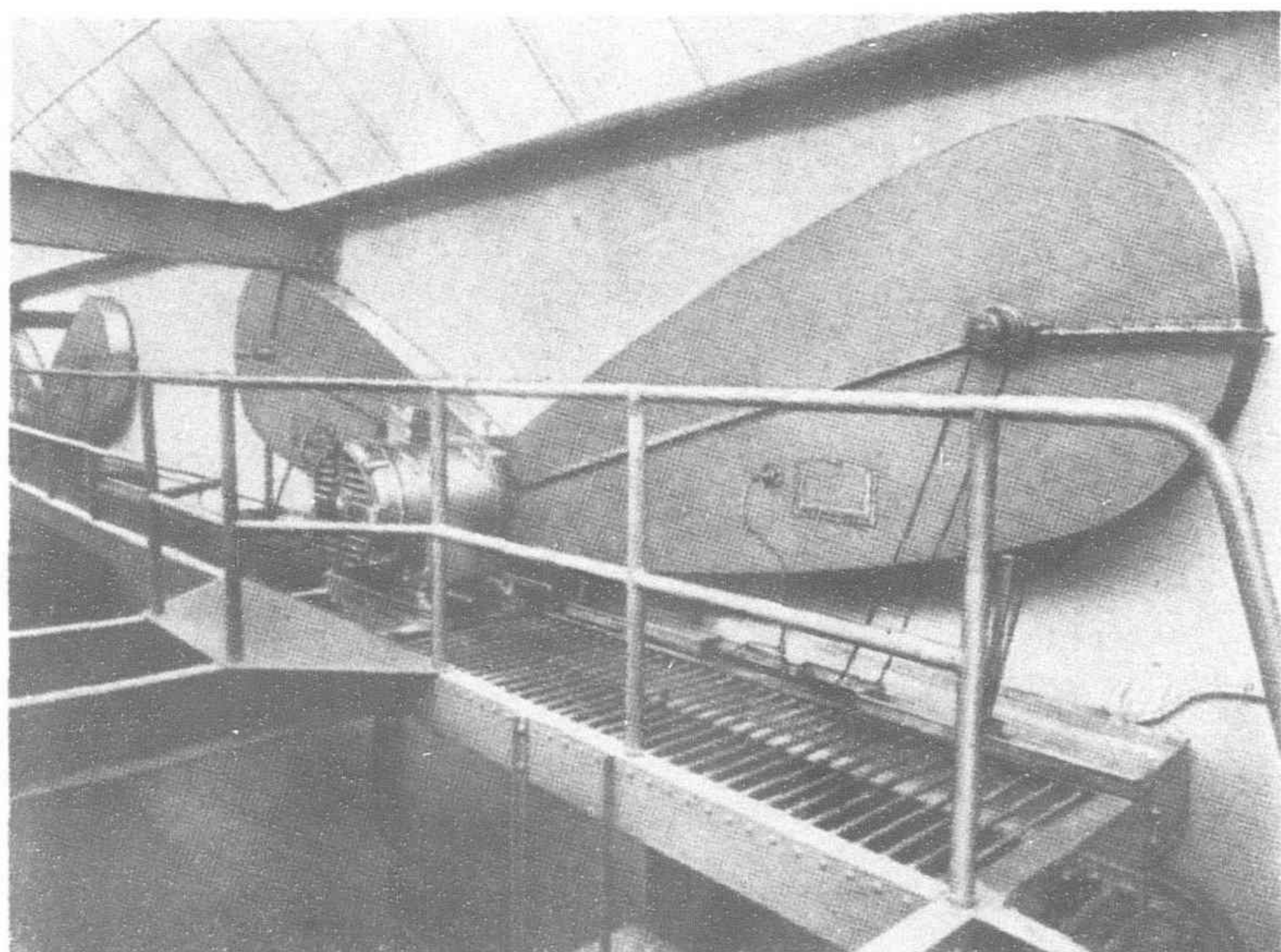


Fig. 16.—Two of the 50 h.p., 759 r.p.m., high torque squirrel cage motors driving line shafting for the weaving looms

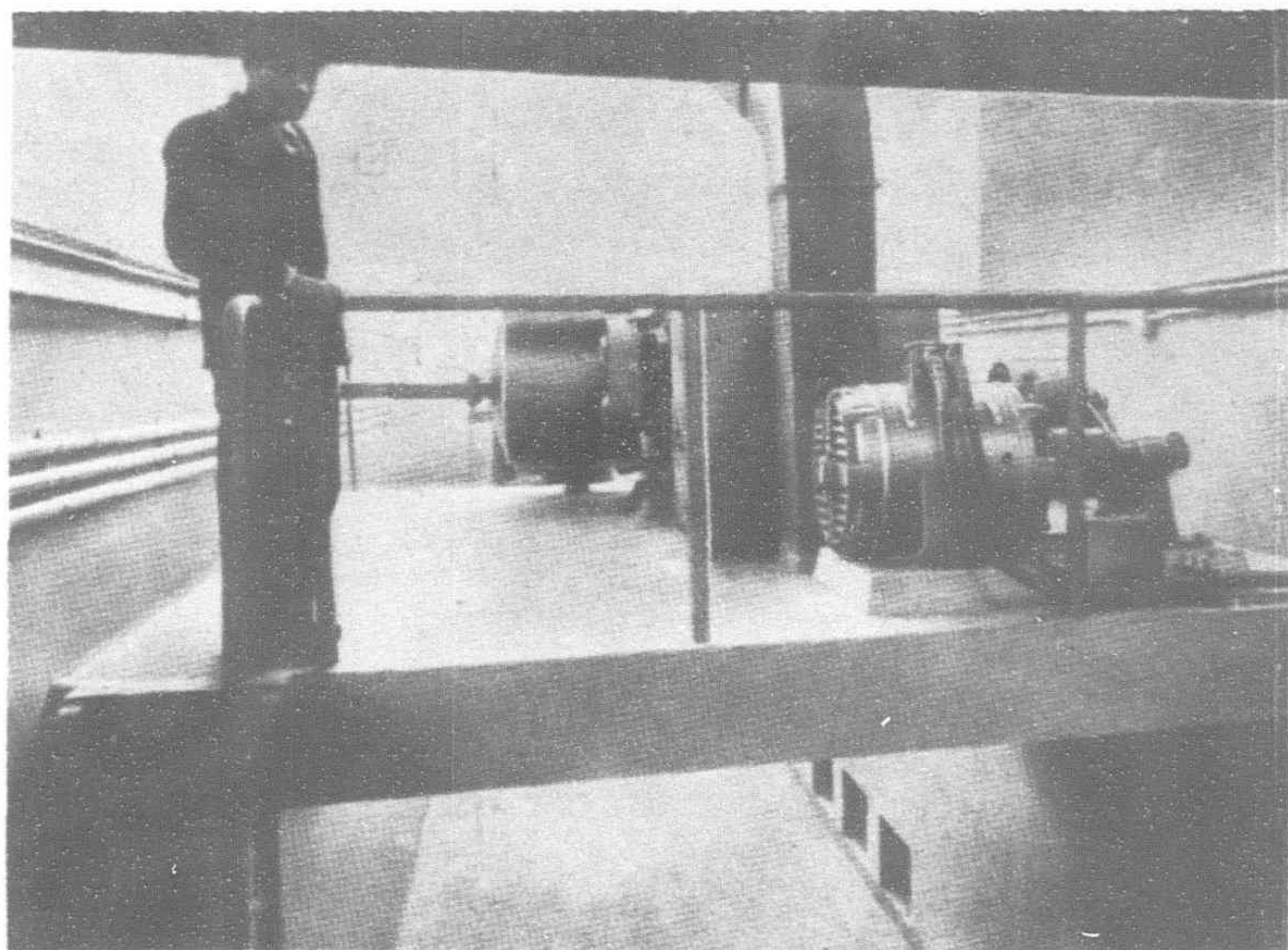


Fig. 17.—Humidifying plants for spinning and weaving mills, driven by 70 h.p. and 55 h.p., 1,470 r.p.m. squirrel cage high torque motors respectively

shown in Fig. 16. The control gear for each motor comprises an oil immersed star/delta starter fitted with an ammeter.

Make Up

After leaving the loom the cloth goes through the final stages of manufacture which consists of brushing, shearing off loose ends, plaiting down and pressing into suitable bundles. The plaiting machines are driven by a 4 h.p. squirrel cage motor by belting from a line shaft, whilst the hydraulic pump for the bundling press is driven by a 15 h.p. motor.

The cloth is now finished and ready for transporting to the company's bleaching, printing and finishing works.

Sampling Room

In order to determine the correct cotton mixings, strength, and spinning quality of the various cottons, experimental machines are installed in a sampling room. These machines comprise drawing, intermediate, ring spinning frames, etc., and are separately driven.

Roller Covering

Special machines are also installed to re-cover the rollers of the spinning and cardroom machinery. These machines are belt driven from a line shaft, the 12 h.p. driving motor being located on the floor in one corner of the room.

Humidifying

Two humidifying plants, one for the spinning mill and one for the weaving mill, are installed to maintain the relative humidity of the air necessary for the spinning and weaving. These plants are driven by 70 h.p. and 55 h.p. motors respectively, and are controlled by oil immersed star/delta starters, Fig. 17.

Power Distribution

Power is distributed from the main feeder panels in the power house, by Pirelli-General paper insulated, lead covered and armored cables laid underneath the ground between the power house and the various buildings. Trenches are provided in the floors of the buildings for the cables, which are led to main fuse and link distribution boards, thence to sub-distribution fuse boards, and finally to the control gear of the various motors. Fig. 13 shows a single line diagram of power distribution from which the various circuits can easily be traced.

The method of distribution from boards MB1 and MB4 to the ring spinning frame starters and motors should be particularly noted. After consideration of the various methods available it was decided to adopt a bus-bar system arranged in a trench between the two lines of ring spinning frames. The bare copper conductors are arranged with the three phases one above the other to prevent short circuits occurring due to objects being accidentally dropped across the phases. The bus-bars are supported on Sindanyo panels and tappings are taken through fuses into a conduit laid underneath the floor to the motor starters which are fixed on to the end frames of the machines. Special waterproof covers are provided for this trench to prevent ingress of water.

It will have been noted from the description of the processes in the mills, that there are many small motors driving various machines in different parts of the mill. The conduit carrying cables to these motors is laid in the sub-floor of the mill before the surface floor was laid, or any of the machines erected.

Lighting and Heating

A large number of lighting, heating and ventilating points are provided throughout the various sections of the mill. These are as follows:—

SPINNING MILL SECTION

Lighting points	603
Lighting plug points	21
Heating plug points	6
Electric siren	1
Unit heaters and exhaust fans	28
Inlet fans	7

WEAVING MILL SECTION

Lighting points	765
Lighting plug points	8
Electric siren	1
Unit heaters and exhaust fans	32
Inlet fans	6
Push button stops for 50 h.p. motors	9

POWER STATION BUILDINGS

Lighting points	74
Lighting plug points	16
Heating plug points	4
Ceiling fans	1
Unit heaters	1

PUMP HOUSE AND JETTY

Lighting points	7
Lighting plug points	4

SEARCHING ROOMS AND WATCHMEN'S OFFICES

Lighting points	15
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OFFICES AND RESIDENCES

Lighting points	120
Ceiling fans with lights	12
Lighting plugs	39
Bells	11
Heating plugs	6

As in the case of the power distribution, P.I.L.C.A. cables are used from the feeder panel in the power house to the main distribution boards in the various buildings. From these boards to the sub-distribution boards and thence to the various lighting, heating and other points, V.I.R. cable run in galvanized conduit is used.

Lighting and Heating

For the lighting, heating and ventilation of the various sections of the mill, over 1,580 lighting points have been installed, 88 lighting plug points, 61 unit heaters and exhaust fans, 16 heating plug points and 26 inlet fans and ceiling fans. As in the case of the power distribution, P.I.L.C.A. cables are used between the lighting feeder panel in the power house and the main distribution boards in the buildings. V.I.R. cable enclosed in galvanized conduit is then used to distribute to the sub-distribution boards. As regards the lighting fittings, over 1,400 dispersive reflectors are installed, equipped with lamps ranging from 40 to 500 watts.

Chinese Railways

The budget, amounting to \$18 millions, for construction of the last section of the Chekiang-Kiangsi Railway between Nanchang, capital of Kiangsi, the present western terminus of the line, and Pingsiang, coal center in western Kiangsi, was adopted in March last.

Construction of the projected railway between Chengtu, capital of Szechuen, and Chungking, the chief river port, started last year. The line will take a route via Kiangtsin and Yungchuan, in order to avoid the mountains. The project is to cost \$48,000,000. Besides a foreign loan of \$20,000,000 for the purchase of materials, a loan of \$10,000,000 is to be secured from the China Development Finance Corporation. The balance is to be shared by the Ministry of Railways and the Szechuen Government.

The Peiping-Suiyuan railway, which has its western terminus at Paotou, is to be extended westward to Wuyuan, in Suiyuan. The section from Paotou to Wuyuan is approximately 110 miles in length.

The Nanking Municipal Government proposes to spend \$300,000 on extension and improvement of the municipal railway. The municipal railway will be extended to Wuhu.

The connecting loop lines having been completed, through train services between the Nanking-Wuhu section of the Kiangnan (Nanking-Chaoan) and the Nanking-Shanghai Railways were inaugurated in April last.

The Recent Growth of Japan's Industries

Present Day Nippon, Supplement of "The Asahi"

AMONG the various branches of Japanese industry, the most remarkable progress has been witnessed in recent years in the mechanical, metallic and chemical industries: and most of the subdivisions under these three branches are usually known as "rising new industries." Some of such subdivisions are so called not because they are really new but because they have developed rapidly recently. In other words what are known as "rising new industries" include many new and other industries which, with their scientific and rationalized methods of production, have developed to such an extent that their output is now more than sufficient to meet the home demand, and some of them are exporting to foreign markets.

What has then spurred these industries on into such sudden activity in recent years? We can enumerate the principal factors as follows:

(1) The rationalization policy adopted successively by the Hamaguchi and Wakatsuki Cabinets to overcome the depression had a far-reaching influence on industries, resulting in a large curtailment of production costs in all branches.

(2) The fall in the yen due to the replacement of the gold embargo in 1931 has stimulated export trade into sudden activity.

(3) The threatened international complications following Japan's withdrawal from the League of Nations stimulated the people's consciousness of the emergency, while demands for the repletion of national defence greatly enlivened war industries.

(4) The economic blocs of the world powers pitted against each other spurred Japan on to the establishment of economic independence, giving impetus to the rise of new industries.

(5) The effect of the "Buy Japanese" movement has been considerable.

In surveying these rising new industries, we shall take up for investigation industries whose production is of late remarkably on the upward trend and some others which are still in their infancy but point to a promising future. These include the following seven industries:

The aluminium and magnesium industries in metallic industry; the motor-car and photographic industries in mechanical industry; and the rayon, ammonium sulphate and coal liquefaction industries in chemical industry.

Aluminium Industry

The present consumption of aluminium in Japan amounts to some 15,000 tons annually, valued at about 20 million yen. However, until 1934, the national consumption entirely depended on imported materials. To-day, two-thirds of the imports are of ore, the remaining one-third being of scrap aluminium.

Judging by the present demand for this metal in Japan, it may be estimated that an annual output of between 12 and 13 thousand tons would make her self-supplying, as the remaining two or three thousand tons can be reclaimed from scrap aluminium.

When, therefore, the Japan Electric Industry Company, claiming an annual production of 7,000 tons, the Japan Aluminium Company in Taiwan, the Japan-Manchoukuo Aluminium Company and several other newly organized companies come in the near future to give full scope to their productive power, the annual output is expected to exceed 15,000 tons.

Consumption of aluminium is widespread to-day. It is used in the manufacture of motor-cars, trains, aircraft, etc., as well as in various household utensils of daily use. Moreover, it is not only used in the manufacture of arms but is also essential in explosive compounds. For this reason, aluminium is very much valued from the standpoint of national defence, and it is generally admitted that without being self-supplying the nation cannot be independent in arms. However, the reported failure in schemes of aluminium manufacture may be attributed to the following reasons:

(1) The absence of bauxite, the material from which aluminium is made, in this land.

(2) The high cost of electricity, which is all important in the manufacture of aluminium.

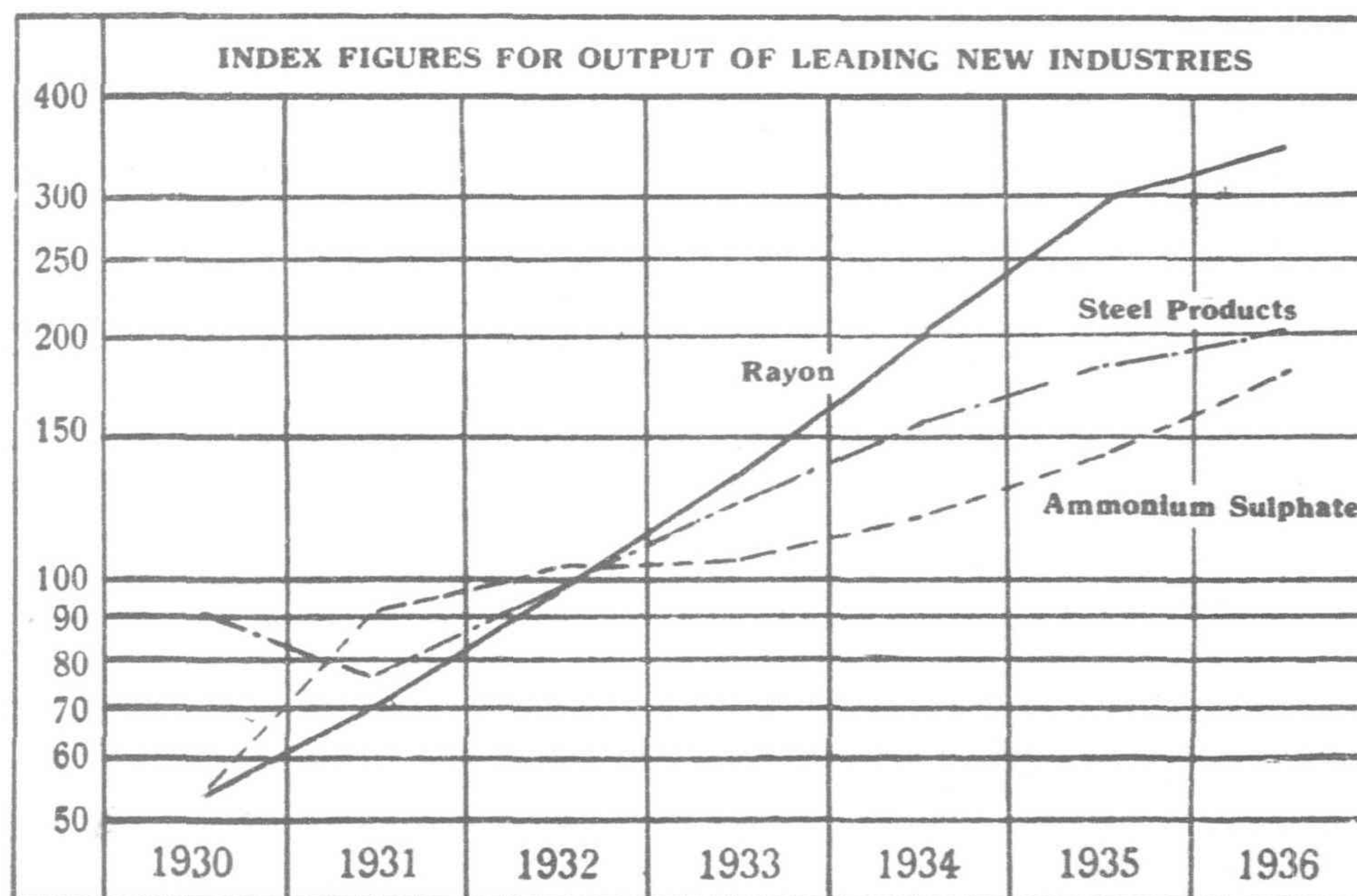
As a result of the gold embargo replacement at the end of 1931, the import cost of aluminium rose from Y.900 per ton to

the present cost of Y.1,900 per ton, while the cost of electricity dropped remarkably owing to its superfluity caused by the far-reaching depression in the period preceding the gold embargo. But it has been discovered that aluminium can be obtained from alum-stones where bauxite is not available. These stones exist in abundance in Chosen, and the problem of material has thus been practically solved.

Naturally enough, taking advantage of these economic and natural conditions, many enterprising companies started manufacturing this light metal. The Japan Electric Industry Com-

pany, the Japan-Manchoukuo Aluminium Company, the Yahagi Industrial Company, the Chosen Nitrogen Manufacturing Company, the Sumitomo Concerns, the South Manchuria Railway Company, etc., took the lead, while in affiliation with the Taiwan Electric Power Company, the Japan Aluminium Company planned to manufacture the metal from imported bauxite.

As a matter of fact, the aluminium industry in this country is led to-day by the Japan Electric Industry Company. The alum-stone used as material by this company is said to be superior to clay in two points. First, an alum-stone generally contains a little more aluminium than white clay, and the stone coming from Chosen contains some 30 per cent of the metal. Second, potassium (7.8 per cent) and anhydrous sulphuric acid (30 per cent) contained in the alum-stone may be utilized for other purposes. Potassium, one of the three elements in fertilizers, is especially valuable, as its ore is unobtainable in this country and has hitherto been imported from Germany and other countries. As for the anhydrous sulphuric acid, ammonium sulphate may be obtained from it by chemical treatment. As outlined above, the aluminium industry in Japan is destined, thanks to active investigations and



Note: Average for 1931 to 1933 inclusive = 100. The figures for 1936 are averages for the first four months. Statistics by the Department of Commerce and Industry

industrialization on the part of these companies, to succeed brilliantly and its development is expected to accelerate the progress of many other industries.

Magnesium Industry

Historically speaking, magnesium is older than aluminium, though more than twenty years younger in point of industrialization. Still it seems to have been industrialized more rapidly than aluminium. In spite of its short history, it seems possible that, favored by nature and manufacturing advantages, the magnesium industry of Japan will develop rapidly and in no distant future compare favorably with similar industries in other pioneer countries. In this sense, this rising new industry may be said to be more hopeful than the aluminium industry. As magnesium is lighter than aluminium by more than 30 per cent, it is widely used in the manufacture of aeroplanes, motor-cars and many other machines, vehicles and tools requiring lightness.

Investigations of aluminium in this country have been seriously carried out with a view to finding a substitute for bauxite, whereas magnesium has long been left uninvestigated owing to its still too small consumption in Japan. To-day, magnesite is generally used in many countries as the source of the light metal, its principal component being magnesium carbonate. Ore of excellent quality is abundant in the neighborhood of Tashihkiao in Manchuria and in the Kankyo district of Chosen. Some ten years ago the Physical and Chemical Research Institute set about investigating in an attempt to extricate anhydrous magnesium chloride from magnesite, but this attempt ended in failure on account of the high cost of production. The Institute, then, some five years later adopted solid bittern as the material, finally succeeding in the attempt to obtain economically magnesium therefrom. With an inexhaustible supply of bittern from the salt fields around the Inland Sea, in addition to an abundant deposit of magnesite ores, Japan may be said to be one of the most favored countries in the magnesium industry.

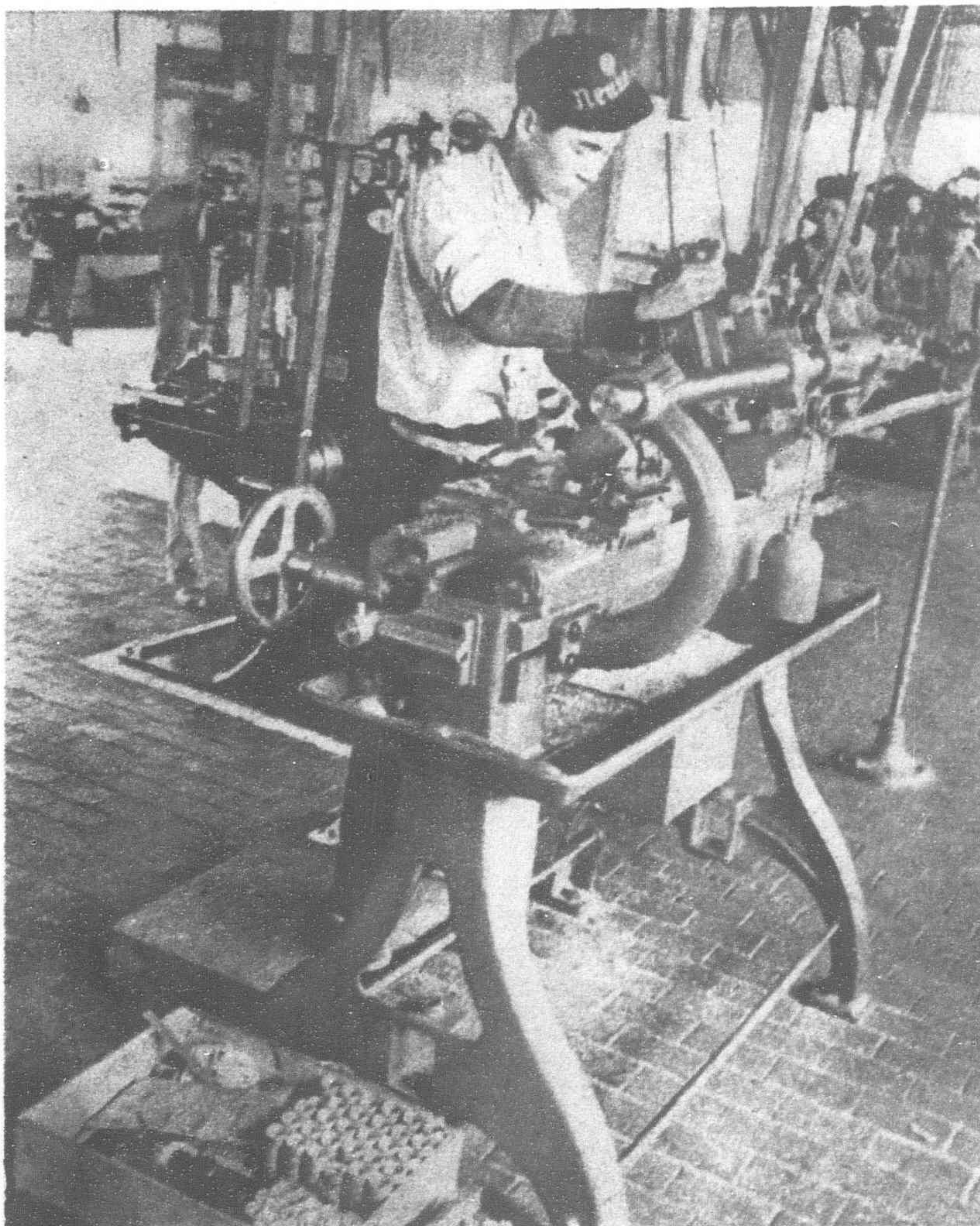
In the manufacturing process, solid bittern is first dehydrated in chlorine gas at 300 degrees C. to change it into anhydrous magnesium chloride. Then by electrolysis the chlorine is isolated to yield metallic magnesium, which is thoroughly refined. One French ton of magnesium can be obtained from between 17 and 20 French ton of solid bittern, which costs Y.12 or Y.13 per French ton, while about 50,000 kilowatts of electricity is said to be required for the manufacture of one French ton of magnesium. The magnesite found in Tashihkiao in Manchuria excels in quality the ores of other countries. When converting the magnesium oxide obtained by burning magnesite into magnesium chloride, an abundant quantity of chlorine is required. But the chlorine isolated in the process employing bittern may be conveniently utilized in this instance. This being the case, the combined employment of the two manufacturing processes would serve greatly to reduce the cost of product.

In the autumn of 1933, the Japan-Manchoukuo Magnesium Company was formed, taking over the magnesium factory under

the Physical and Chemical Research Institute at Naoetsu, Niigata prefecture, at the same time establishing a new factory at Ube, Yamaguchi prefecture, for the employment of the magnesite process invented by the South Manchuria Railway Company. With an output of 400 tons a year, this newly formed company ranks among the leading companies of the world. In order to increase its tensile strength, elasticity and solidity, magnesium is usually put into practical use in the form of a compound metal, containing in tiny quantities aluminium, zinc, manganese, etc. With the development of cultural life, not to mention, flash-light photography, this means of flash illumination will increase in demand. Moreover, magnesium is indispensable in the making of illuminating and incendiary shells.

The question that always confronts any rising new industry in its early stage is the question of the price of the product. Domestic magnesium cost, several years ago, some Y.5,000 per French ton while the imported product was sold at about Y.4,000

per French ton. The product of the Japan-Manchoukuo Magnesium Company is at present marketed at about Y.3,500 per French ton, but when it is taken into consideration that the specific gravity of magnesium is about two-thirds that of aluminium, which costs some Y.1,700 per French ton, it will, in comparison by volume, be equal in price to aluminium only when it is marketed at Y.2,600 per French ton. The cost of the product, however, remains a problem yet to be solved in the future.



In a Camera Factory

Motor-car Industry

The new age of domestic production is now dawning upon the motor-car world of Japan, which has long been dominated by Fords, Chevrolets, and other cars of American manufacture. It is thought that the development of this industry in Japan has been chiefly arrested by (1) the smallness of the demand for motor-cars owing to the low standard of living of the people in general and (2) the still imperfect network of paved roads. Not until 1921 were there over 10,000 motor-cars in use, but with the development of communications and the completion of the nation-wide network of

paved roads, the number of motor-cars has every year increased, till at last it reached the 100,000 car level in 1932. As is generally admitted among motor-car manufacturers, the motor-car industry cannot prosper unless, at least, 100,000 cars are in use in the country. Meanwhile, Japan found that motor-car accessories could be manufactured in large quantities at lower costs in her smaller factories and works than in the United States. It is very natural that the motor-car industry has now grown from this seed bed, with promise of developing into one of the great industries of this country. Setting 100,000 cars as the standard figure and five years as the life of a car, it is necessary yearly to replenish 20,000 cars. The manufacture of 10,000 cars a year would pay sufficiently even if the increasing tendency to use motor-cars were not taken into account. It is confidently assumed that in the future cars will increase every year by ten per cent while judging by the population, geographic situation, area, etc., it is estimated that the largest possible number of cars in the future will be 500,000 or thereabout. In addition to this possible demand for 400,000

more cars, there is a newly opened market in Manchoukuo. In its market, the Japanese motor-car industry really has a brighter future before it than any of its European or American predecessors.

For many years the Department of Commerce and Industry has been associating itself with keen interest with the independent manufacture of domestic motor-cars, and in 1933 through its instrumentality the Ishikawajima and the Dai motor-car companies effected an amalgamation and became the present Automobile Industry Company. According to the report of the Committee for the Investigation of the Establishment of a Motor-car Industry, the Department set up several years ago a fixed standard for motor trucks and buses, appropriating ¥130,000 as a yearly subsidy to standardized cars at the rate of about ten per cent of their market prices. Standardization was effected on trucks and buses, because they are not constructed in large quantities in other countries and therefore their cost is comparatively high. But what is really necessary for establishing Japan's motor-car industry, is beyond doubt the extensive production of such popular cars as those of the Ford and Chevrolet class. In keeping with this demand, the Automobile Industry Law passed by the 69th session of the Imperial Diet provides, from the standpoint of both industry and national defence, a license system for this special industry. Now that the licensees under this law will be granted such privileges as (1) exemption from business profit tax, income tax and local taxes during a certain period, (2) the right to raise loans above the amount fixed by the Commercial Code, (3) exemption from import tax on certain motor-car accessories, and other machines, etc., a marked development is expected in this line.

Photographic Industry

The present state of development of the photographic industry in Japan is attributable to the untiring investigations voluntarily carried on by civilian manufacturers. But at the same time since 1926 the Department of Commerce and Industry has been eagerly working for the independence of the photographic chemical industry. The Department has every year granted "an industrial subsidy" for investigation work ¥118,000 having so far been spent for this purpose. Directly and indirectly affected, however, by the inflation boom caused by the manufacture of munitions which has prevailed for several years, this industry has taken long strides in all its branches. Such chemical products as films, dry plates, printing paper, and such materials as celluloid, gelatine, nitrate of silver, etc., all of excellent quality, are now being successfully manufactured; and precise and optical instruments such as lenses, filters, shutters, cameras, etc., not inferior in quality to the products of other countries are also being made. Not only have these home products eliminated by leaps and bounds the importation of foreign goods, but they are to-day being exported to China, Manchuria and the South Sea Islands.

For convenience's sake, however, the manufacture of printing paper, dry plates and films shall be treated here as branches of photographic industry in spite of their chemical nature.

Printing Paper Manufacture

The manufacture of printing paper for photographic use was first carried out in Japan as early as 1902, when the Rokuosha succeeded in its attempt to manufacture it independently. Manufacture was also started in 1907 by the Japan Photographic Industry Company, which, twice receiving in 1926 and 1927 a Depart-

ment of Commerce and Industry subsidy, has finally succeeded in the production of printing paper of excellent quality. The Oriental Photographic Industry Company and the Asahi Photographic Industry Company formed in 1919 and 1925 respectively, launched out into the manufacture of gaslight and bromide paper. At the end of 1933 the Showa and the Fuji photographic industry companies were added to the list. Thus the home production of printing paper is now sufficient to cover the whole demand in the country, though gaslight and bromide paper of middle and higher grade qualities must still be imported in considerable quantities. Of the two, bromide paper will continue to be imported for some time to come.

Dry Plate Manufacture

The manufacture of dry plates was practically established as an enterprise when, after four years' laboratory investigations, the Oriental Dry Plate Company, formed in 1919, put its excellent products on the market in 1923. Granted an "industrial subsidy" by the Department of Commerce and Industry in 1926 and 1928, this company is engaged in the manufacture of ordinary dry plates and some other special plates of high sensitivity. However, though on the gradual decrease, the importation of high-class dry plates and some special plates including those of high sensitivity will continue for some time yet.

Film Manufacture

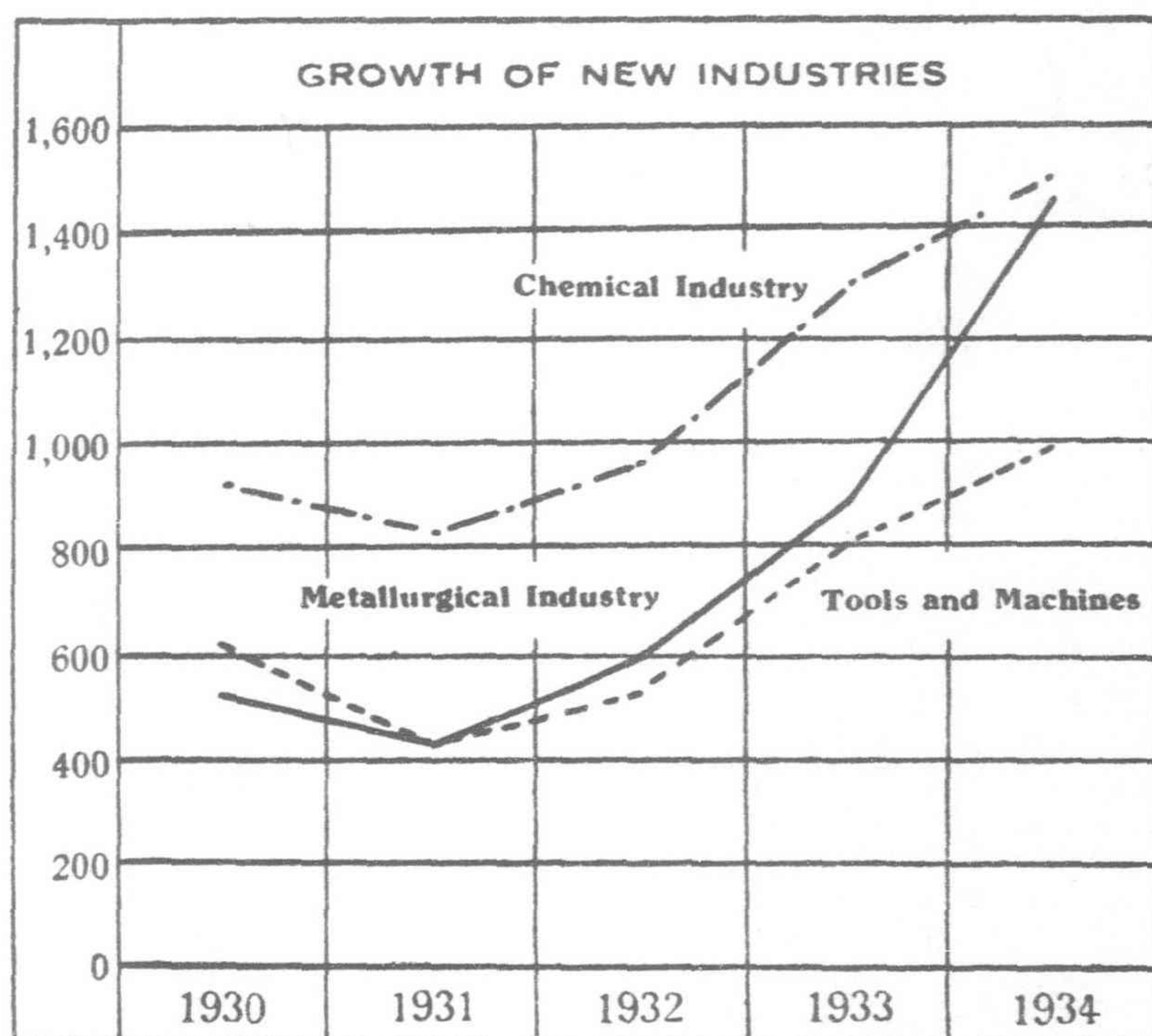
Among the various branches of photographic industry, the manufacture of photographic films was the latest to be established in Japan. Although investigations on its industrialization were launched as far back as 1922 by the Konishi Company in its factory, Rokuosha, they made only slow progress until the company was granted a government subsidy in 1928. Spurred on by official encouragement in this form, the company finally succeeded in the next year in the industrialization of the manufacture of films. In 1927 the Asahi Photographic Industry Company also successfully turned out films and put them on the market. Both companies have since been growing

prosperous in the business, the Rokuosha having later extended its activities to the manufacture of special films for aerial photography, infra-red ray photography, 16 mm. motion picture cameras, etc.

As regards the industrialization of motion picture film manufacture, the Dai Nippon Celluloid Company established in 1930 a special section to undertake investigations, receiving a Government subsidy the following year. It was renamed in 1934 the Fuji Photographic Film Company, which later purchased the Oriental Dry Plate Company. Supplying a large output of films and dry plates to the market, this company now claims to be the foremost manufacturer in Japan's photographic chemical industry.

Lens Manufacture

Though it is an industry of very recent origin, the manufacture of lenses has lately made, under the influence of the war industry boom, a sudden remarkable progress, especially in technique. With the government subsidy granted in 1932, the Tomioka Institute for the Optical Industry devoted itself to the mass production of lenses, and succeeded in the manufacture of F. 4.5 quadruple lenses. The Japan Optical Industry Company has also succeeded in the manufacture of F. 3.5 lenses, thus giving impetus to the rise of the camera industry of this country.



Based on investigation made by the Department of Commerce and Industry. Unit, one million yen

Camera Manufacture

Collapsible cameras have been manufactured by the Rokuosha since 1882, but in spite of this very old history of camera manufacture, kodaks have come to be made in this country only recently. It was in 1926 that the first kodak of the vest pocket size was successfully made in Japan, while in 1933 the first Japan-made kodaks of $\frac{1}{2}$ vest pocket size were marketed in sharp competition with imported kodaks. Furthermore, this camera works has turned out in succession many special cameras for aerial photography, newspaper photography, police photography, and medical and other scientific photography. In 1933 the Rokuosha made a new Leica-type camera known as the "Kwannon camera" and marketed it at half the price of its German prototype.

Rayon Industry

The wonderful development of the rayon industry in recent years really stands for the rapidly progressing industries of Japan. Taking full advantage of its excellent manufacturing process and low weaving cost, the rayon industry has now overwhelmed the world market to the sorrow of other pioneer countries engaging in this industry.

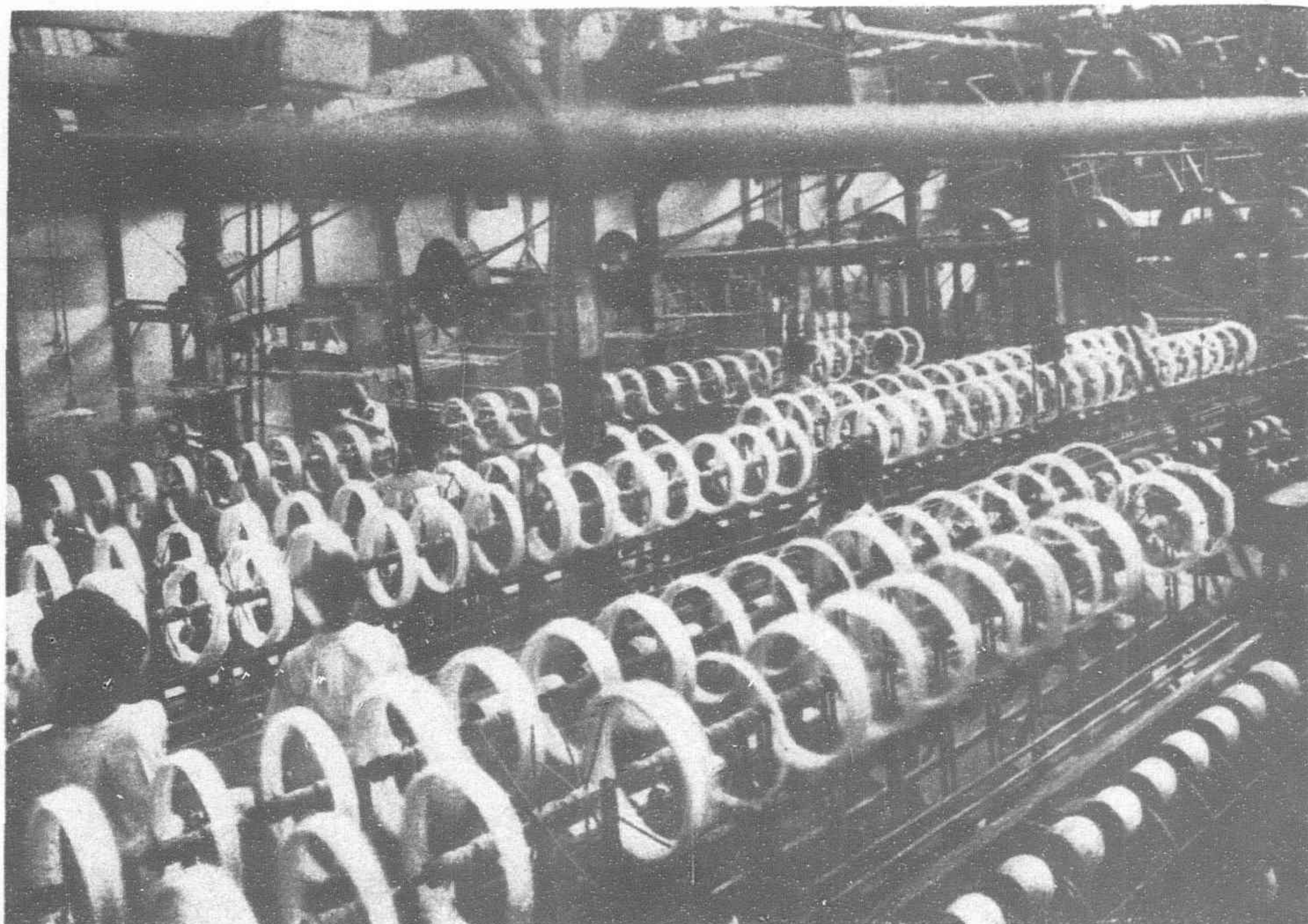
The output of rayon in 1934 is estimated to have totaled 150 million lb., which, compared with that for 1931, was an increase of nearly 350 per cent. The outputs for 1935 and 1936 estimated at 220 million lb. and 300 million lb. respectively.

Japan's rayon production in 1930 was only nine per cent of the world total, but in 1932 Japan outdistanced France and, in the following year, ranked next to the United States. In no distant future, Japan will be able to get ahead of the United States as the world's largest rayon producer. However, owing to the balance of demand and supply which is disturbed by rapidly increasing production and high tariff walls, the industry has been brought face to face with a very difficult situation. Still, thanks to its unrivalled merits and advantages, this brilliant industry is expected to be able to tide over its difficulties in the long run.

During the eight years from 1918 to 1925, this industry remained undeveloped, being still in an experimental stage. The annual output, for instance, for 1925, was only three million lb. or so. But confronted by the import tariff walls raised by the Government in the same year, cotton spinning companies and other industrialists became keenly alive to the necessity of manufacturing it, this resulting in the springing up of manufacturing companies in large numbers. This rising tendency was greatly accelerated by the replacement of gold in 1931; the industry has since made epoch-making progress in scale of manufacture. Stimulated by the increasing demand and the rising price of rayon, the existing companies effected a vast expansion in equipment, while many new companies were organized in great haste.

Rayon exports before 1929 remained very small. But a drop in market price in that year promoted exportation to China, while as a means to relieve the home market of confusion, the Rayon Federation adopted in December of that year a decision that its member companies should be responsible for the exportation of a certain amount of their products. These powerful factors have since served remarkably to increase exportation. Here, the gold embargo in 1931 added the decisive spur, and suddenly increased rayon exports. Rayon is mostly exported to Oriental countries, though it is noteworthy that the demand in Manchoukuo and India has largely increased since 1933 and 1934.

Consumption of rayon yarn has been much affected by rayon textiles. In Japan it has been used by many silk textile manufacturers, first to be woven mixed with silk and then as material for all-rayon textiles. Success in the exportation of rayon textiles has put their manufacture into universal fashion. But at the same time rayon has of late been much utilized in the weaving of mixtures with cotton and wool for the use of the Japanese people; and weavers have succeeded in making new kinds of textiles with this artificial silk. Thus the demand for rayon is growing both at home and abroad. The exportation of rayon



In a Rayon Mill

textiles which began to be brisk in 1928 reached 47,500,000 square yards in 1929 and 84,200,000 square yards in 1930. The gold embargo in 1931 again helped this export business, and in 1934 the exports exceeded Y.110,000,000. Rayon textiles are really one of the most important Japanese exports, ranking next to raw silk and cotton textiles.

Coal Liquefaction Industry

The oil deposits of Japan being exceedingly meagre, only 10 per cent of its annual consumption is supplied by domestic oil. The oil policy, therefore, forms a problem of vital importance, not alone from a military standpoint but also from an industrial standpoint. The steps now being taken by the Government to relieve the oil difficulty include the encouragement of the acquisition of oil resources in other countries, compulsory oil storage, and the investigation of substitute fuels for oil. Naturally enough, coal liquefaction here plays an important rôle. In coal liquefaction, two methods are used in Japan.

Oil manufacture by this method, invented in Germany in 1913, has been under investigation since 1920 in the Fuel Research Institute of the Department of Commerce and Industry. In 1922, as a result of the investigations of the Institute, the Osaka Low Temperature Coal Carbonization Company was established, but unfortunately it died a very early death for want of capital. But the Kaijima Low Temperature Coal Carbonization Company is now operating in Osaka. Other companies of the kind, either in operation or in embryo, are as follows:

The Chosen Coal Company: Established in 1931, it annually treats 200,000 tons of brown coal produced in Chosen for oil manufacture.

The Japan Iron Company: It annually treats between 300,000 and 400,000 tons of coal for oil manufacture. Its factory at Rinsei is to be completed this year.

The Mitsubishi Mining Company: Through its subsidiary company, the South Saghalien Coal Mining Company, it is now constructing a factory with a capacity for treating 150,000 tons of coal a year.

In addition to these, there are the Japan Low Temperature Carbonization Industry Company and the Japan Fuel Industry Company still in embryo. Though the enterprise seems not yet to be paying, these companies proclaim they must succeed even with a temporary loss. The Department of Commerce and Industry annually grants subsidies totaling some Y.300,000.

Transmutation of Coal into Oil

This method of oil manufacture has appeared in the wake of low temperature carbonization. It is reported that the South Manchuria

(Continued on page 80)

The High-Tension Laboratory of the National Tsing Hua University, Peiping

THE important position which electrical services have assumed in China during recent years, has resulted in a rising demand for skilled technical personnel. Consequently, the technical colleges and universities have found it necessary to train many electrical engineers, and educational facilities have, therefore, had to be enlarged in every direction, laboratory equipment receiving special attention.

Recognizing the importance of high-tension technique, the electrical department of the Tsing Hua University, Peiping, has built a modern high-tension laboratory. Fig. 1 is a view of part of the equipment, which was developed and manufactured on up-to-date lines by the AEG.

The room available for use as high-tension laboratory was 41 by 25-ft. (12.6 by 7.5 meters) in area and 15-ft. (4.6 meters) high. It was essential that, in spite of the small size of the room, the layout and the apparatus should be adequate not only for ordinary potential measurements but also for research into surge stresses, travelling waves, induction phenomena, the behavior of cables, and the flashover voltages of insulating materials. All apparatus, except the testing transformer, the regulating transformer, and the switchdesk is readily portable, thus permitting satisfactory arrangement of the components for every variety of test.

High-tension current is produced by a single-phase testing transformer rated 35 kva at 250 kv, 50-cycles, one pole being solidly earthed. The supply is drawn from the A.C. mains through a regulating auto-transformer, the primary of which is wound for 220-v and the secondary for fine-stepped regulation from 0 to 440-v. The regulating transformer contains a main winding divided into four equal sections, and an additional winding whose full voltage equals that of each section.

The additional winding is provided with numerous tappings, which lead to a selector switch resembling a commutator. It is switched stepwise into series with the sections of the main coil, thus giving smooth regulation between the four coarse main steps. The main sections are automatically switched in and out during operation of the fine regulating switch.

High-tensions are measured by a precision spark-gap with 10-in. (25 cm.) spheres arranged vertically. Motor remote control serves to vary the height of the lower sphere, the gap length being shown by a directly attached indicator. The upper sphere is fixed. Spheres of other diameters can be fitted.

An electrostatic voltmeter is available for direct indications of D.C. and A.C. (r.m.s.) tensions up to 250 kv.

Surge equipment has been installed for research into the behavior of insulators, lighting arresters, etc., under travelling waves, such as are produced in high-tension systems by atmospheric discharge or switching operations. The surge generator multiplies the voltage mechanically and produces surges up to 230 kv (crest). It consists of two condensers enclosed in bakelised paper, each of 0.178 μ F (16,000 cm.) capacity. They are charged in parallel, then connected in series by a switch and discharged via a trigger gap through the article under test. The change-over switch is driven by an electric motor

and runs continuously. By adjustment of the speed of the motor the frequency of the surges can be set as desired. All parts of the surge generator are mounted on a common base plate (Fig. 2).

The condensers are charged at 115 kv D.C., obtained from a portable hot-cathode rectifier (Fig. 3); a three-range ammeter serves for measuring the anode current. The filament heating

(Continued on page 80)

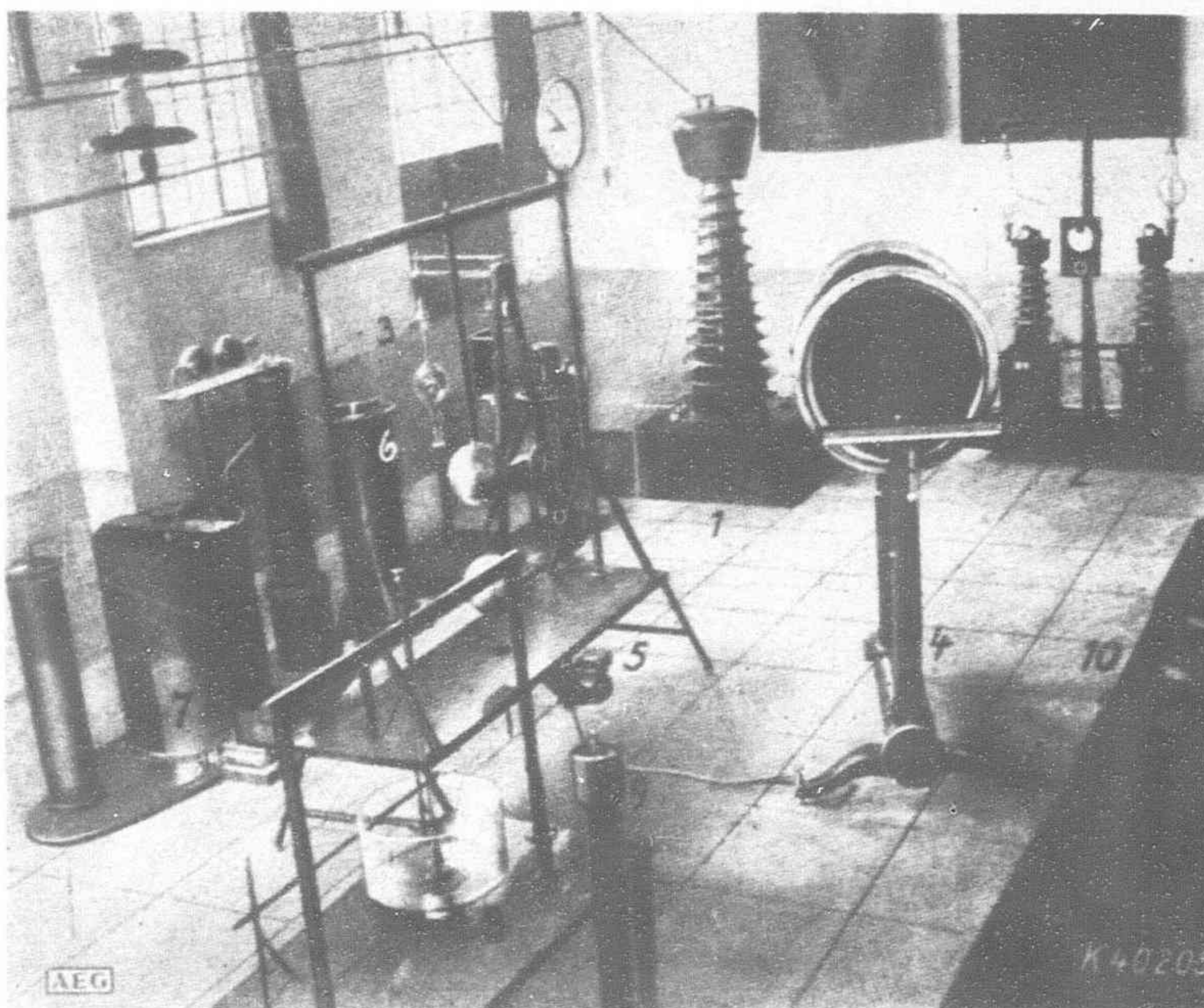


Fig. 1.—Part of the equipment of the High-tension Testing Laboratory

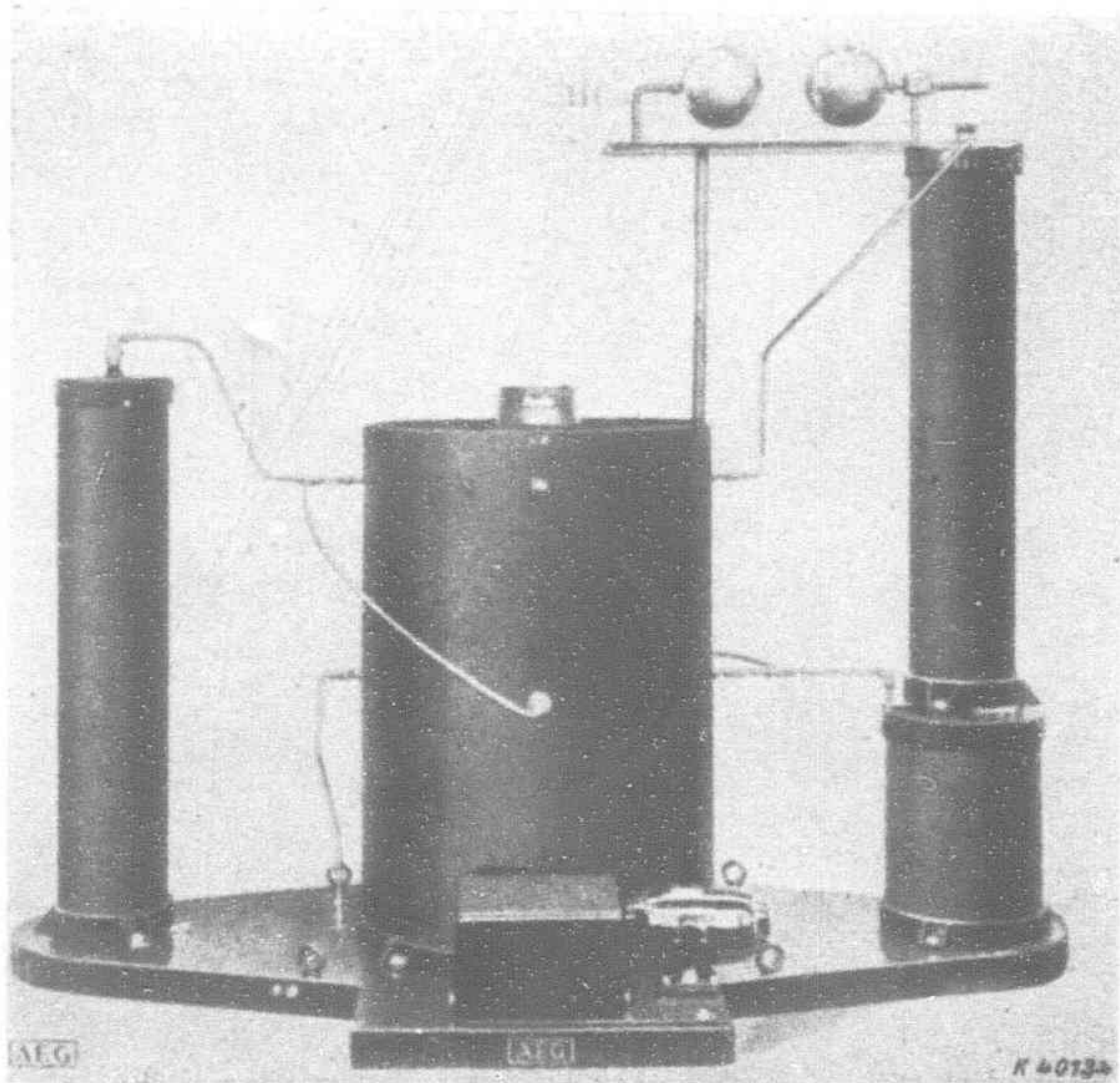


Fig. 2.—Impulse generator with mechanical voltage multiplying device for impulses up to 230 kv



Fig. 3.—Half-wave rectifier with Filament Heating Motor-generator, for 115 kv D.C.

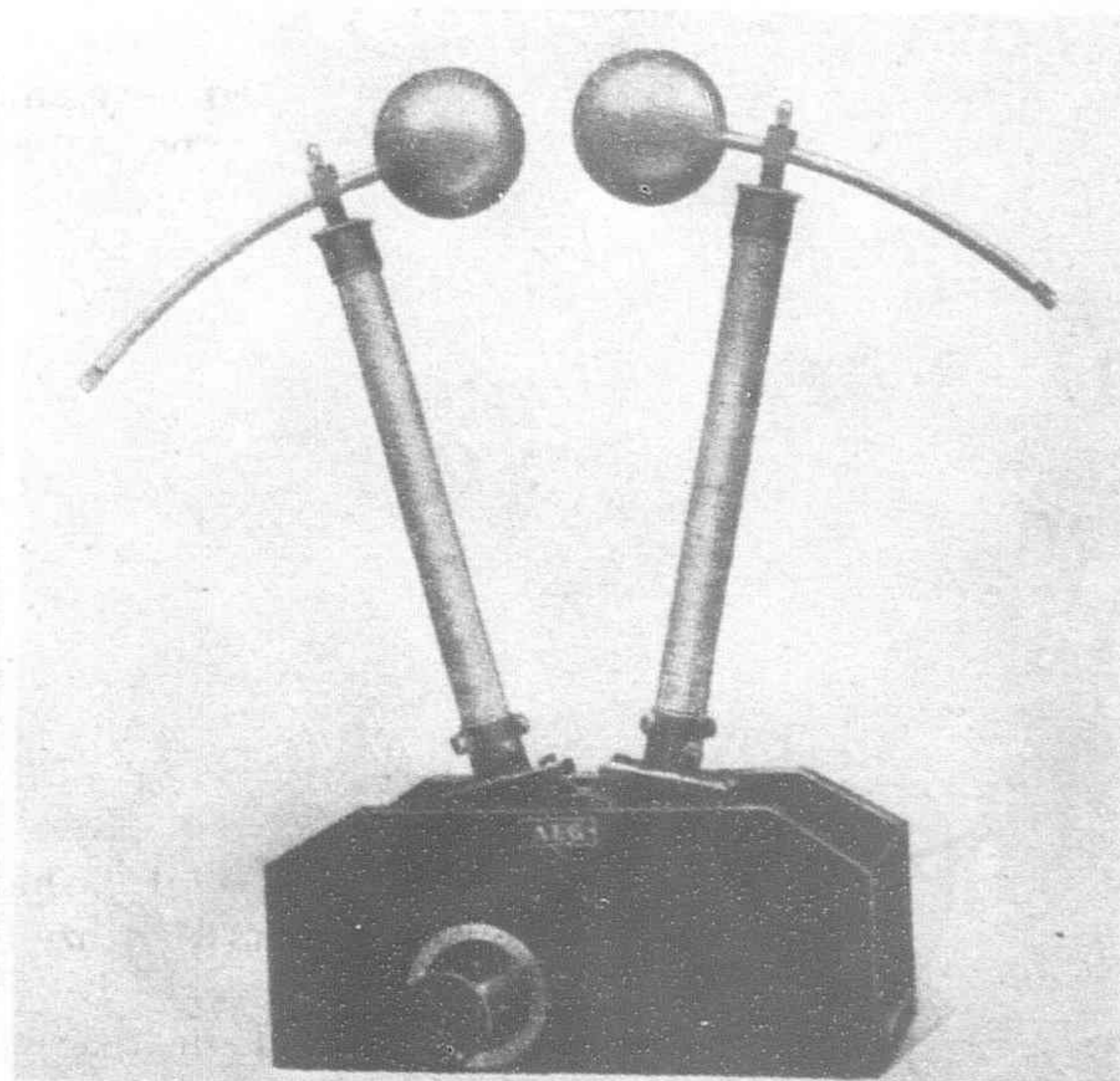


Fig. 4.—Control gap for Potentials up to 150 kv

The Central Workshops of the Malayan Railways

Past and Present

(This article is the fifth of a series reviewing the history and progress through a half century of the railways of Malaya, compiled from a record published by the Federated Malay States Railway Administration. The preceding articles, "Fifty Years of Railways in Malaya," "Railway Bridges and Railway Buildings in Malaya," "Locomotives of the Malayan Railways" and "Rolling Stock of the Malayan Railways" appeared in the April, July, August and September numbers of *The Far Eastern Review* last year).

THE Workshops of the F.M.S. Railways are situated at Sentul, three miles to the north of Kuala Lumpur, and adjoining the branch line to Batu Caves.

The work of amalgamating at one center, the repair establishments of the Perak and Selangor Government Railways, was started in 1904, and the shops were available for use in 1906. As in other matters affecting the development of the railway, considerable foresight was exercised in the location and purchase of land in view of the great increase in plant necessitated by the growth of the system. The design of the shops themselves was representative of the times, and although not entirely in accordance with modern ideas, no great difficulty has been encountered in adjusting the layout to meet more recent developments.

Of 56 acres occupied by the shops approximately 11 are roofed. The growth of buildings, has, of course, been gradual, and it is interesting here to refer to the panoramic photograph as well as to the plan and aerial view reproduced on the next page. The central traverser is still the principal means of transverse communication for heavy materials. On the left of the photograph is seen the erecting shop, flanked on the left by the machine shop and on the right by the fitting shop. This shop is now 600 feet long, having been twice extended, the northern addition being of two storeys. The main divisions of the building still exist, though each section has now its own machines, and the fitting shop is now a specialized machine shop. The erecting shop is equipped with three overhead cranes of 25 ton capacity each.

Other modern improvements are visible. The brass-finishing shop is located on the floor above the wheel bay and contains complete testing equipment. Electricity is used in heating tyres preparatory to shrinking them on to the centers. A well-found tool room has been added which is responsible for the care and maintenance, and in some cases for the manufacture of, all small hand and machine tools, jigs and accessories. Last, but not least, locomotives entering the shops for repairs are immersed wholly in a caustic soda bath, a process which saves considerable time in cleaning the many parts of which the engine is composed, and which require inspection and repair.

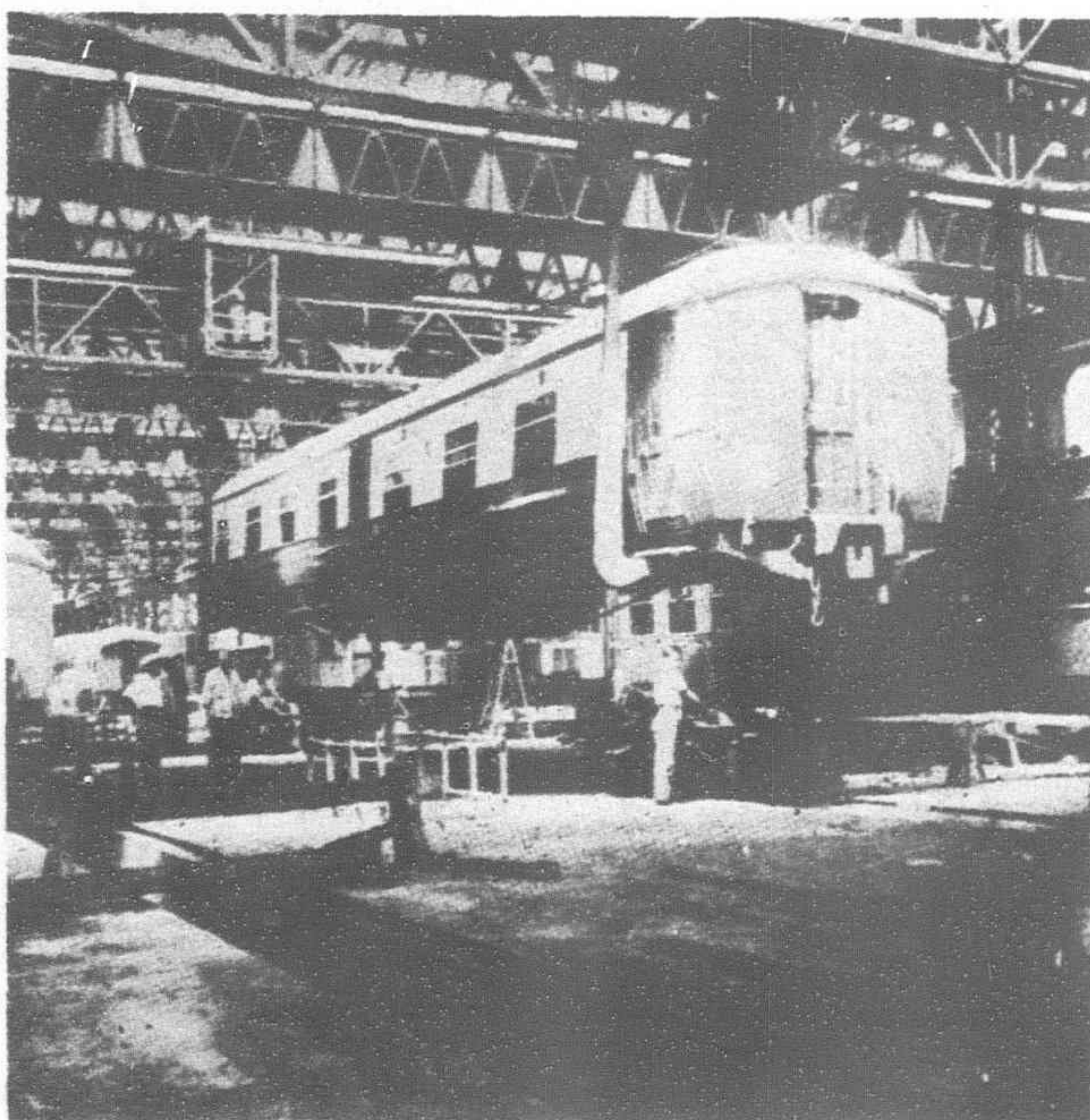
At the right end of the next block is the power house. Central workshops has always been electrically driven and at first obtained current from the Government supply at Gombak. This was supplemented after the War by a steam-driven generating set. On the establishment of the Bungsar Power Station and ring main, the building was converted to a substation where current is transformed from 11,000 to 400-volts. Behind the power house are the foundries, somewhat extended in these days and fitted with modern plant. All castings required for repairs of rolling stock are made here, Chinese labor being employed.

The building seen next in the photograph was the original wagon shop. The nearest two bays however were, on the introduction of road services, utilized for the repair of motor buses and lorries, of which the railway had a considerable fleet. On the closure of these services about 1917, the shop was used for tin-smiths and copper-smiths work. The remainder of the building was found to be totally inadequate for the repair of wagons, which work was scattered about the yard until 1923 when a new wagon shop was opened, to which reference will be made shortly.

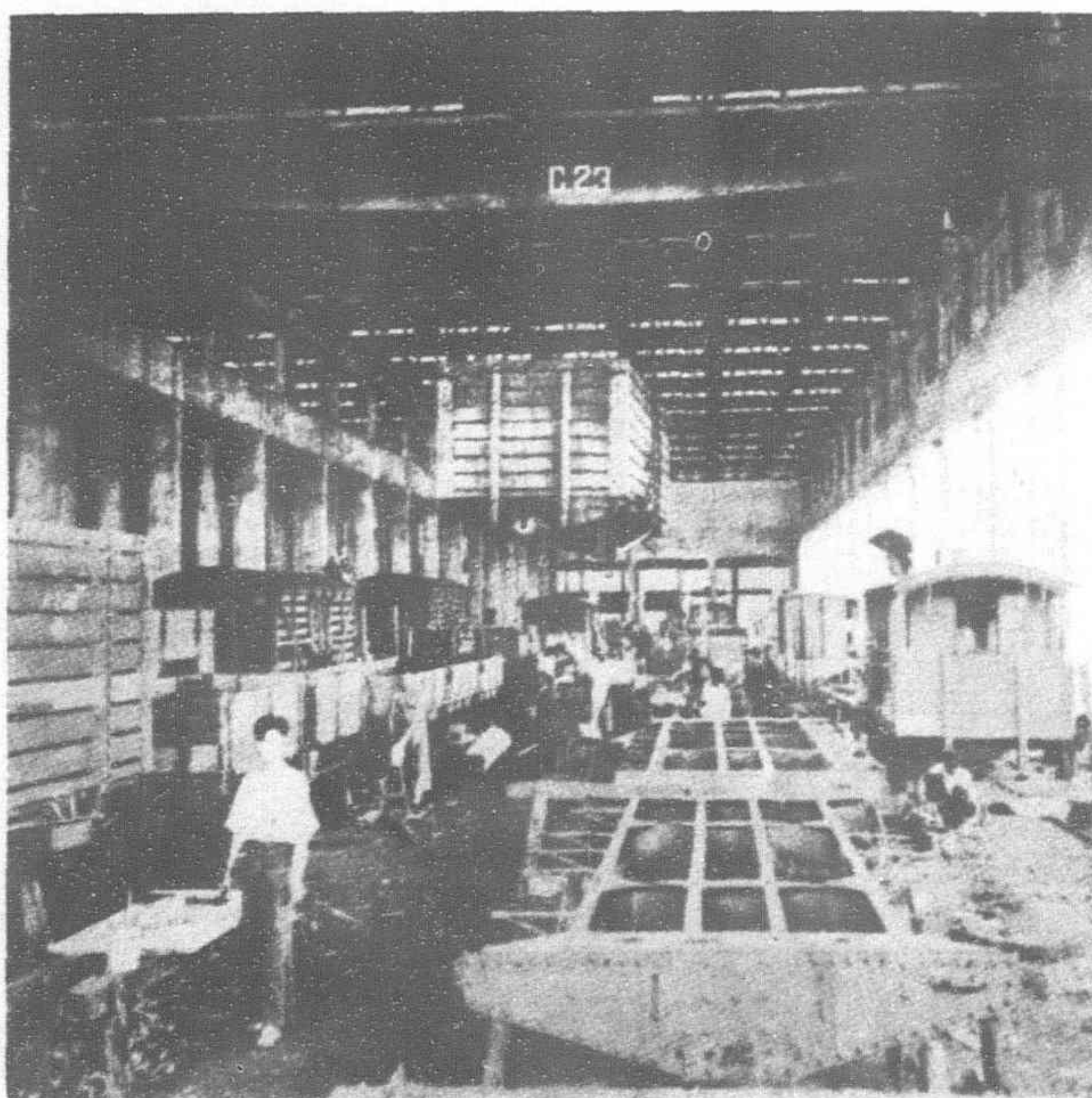
The block of buildings at the far end on the right hand side of the traverser was originally the carriage shop, to which a small saw mill was attached. Here, again, the accommodation was insufficient, and no provision for lifting was provided, and in 1916 there was opened on the vacant site on the right foreground of the

panorama a new carriage shop, of which mention will be made later in this article. For some time the old carriage shop was used for the construction of new coaches and wagons, while the opportunity was taken of extending and re-arranging the saw mill. The building was not of a convenient shape or design, but nevertheless a layout that permitted a form of progression in the various operations of sawing and milling timber was evolved. The timber yard and seasoning sheds are to the north of this building. Part of the old carriage shop is still reserved for special work, but the remainder forms an annexe to the new wagon shop. Here are housed the lathes and benches necessary for the repairs to wagon wheels. The wagon shop, itself, is built as an extension to the building and is of reinforced concrete construction 350 feet long. There are two bays, each covered by a crane of 12 tons capacity. The two out-going roads lead through a spray painting shed to the wagon weighbridge.

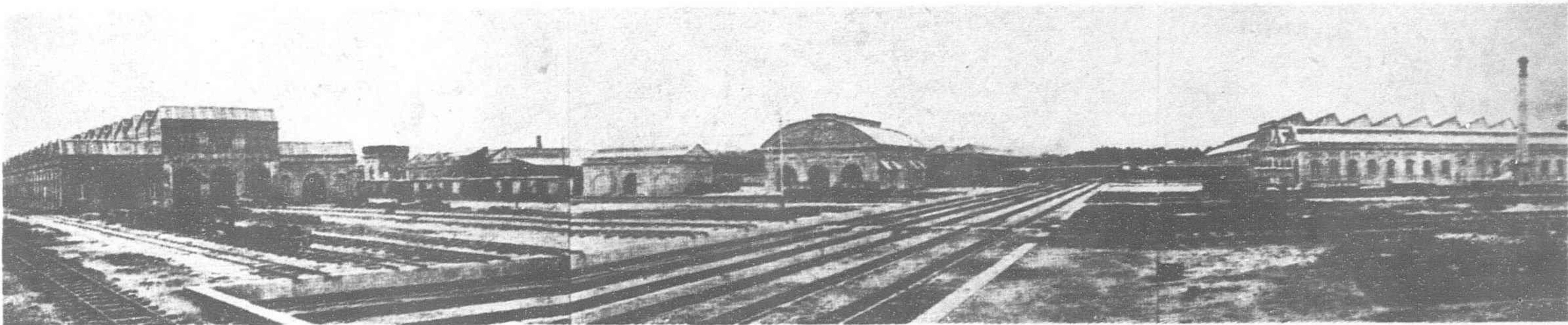
Proceeding towards the camera, on the right hand side of the traverser, the boiler shop is reached. This building was originally separated from the carriage shop, but the roofing over, and the formation of an annexe of the intervening space was an early extension. Reinforced concrete was again used to extend the boiler shop in 1919. The equipment is up to date, both hydraulic and air power



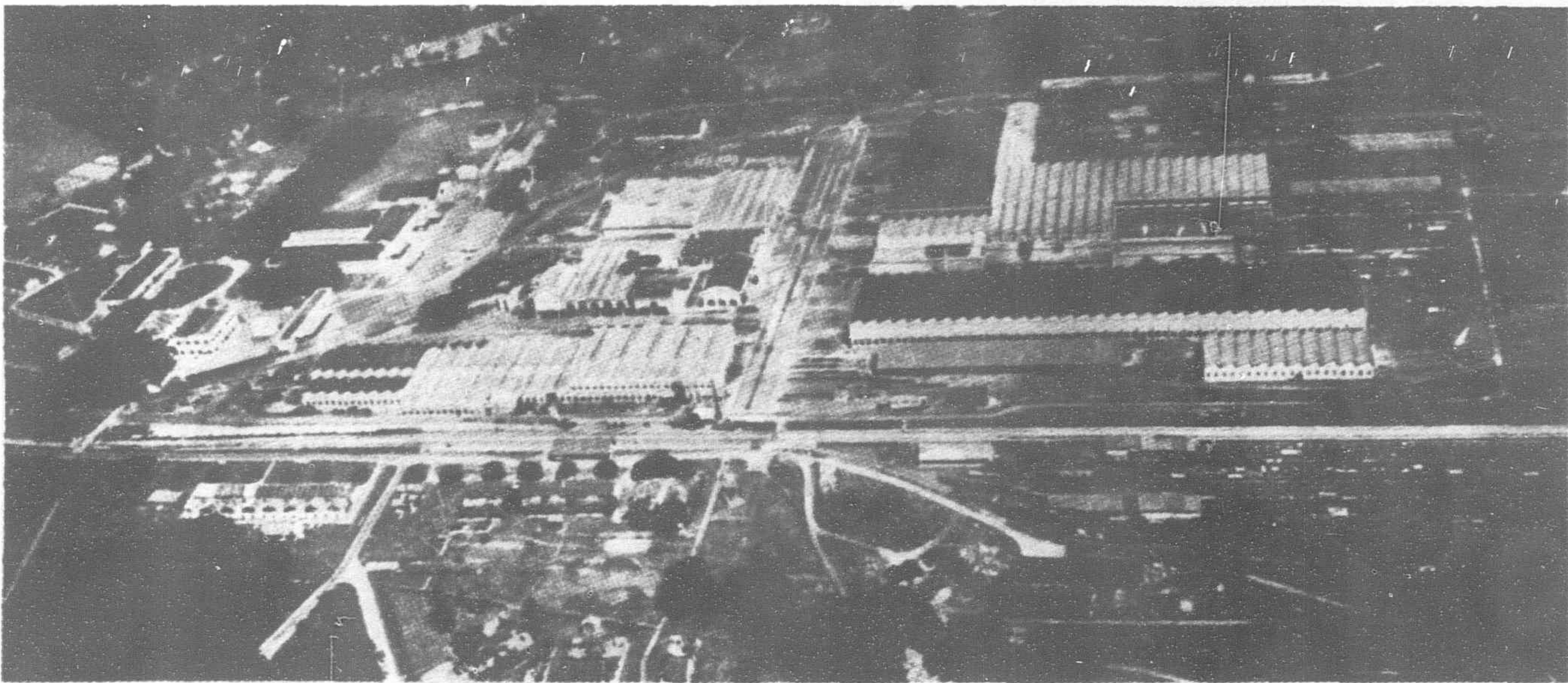
One Bay of Carriage Shop showing Crane in use



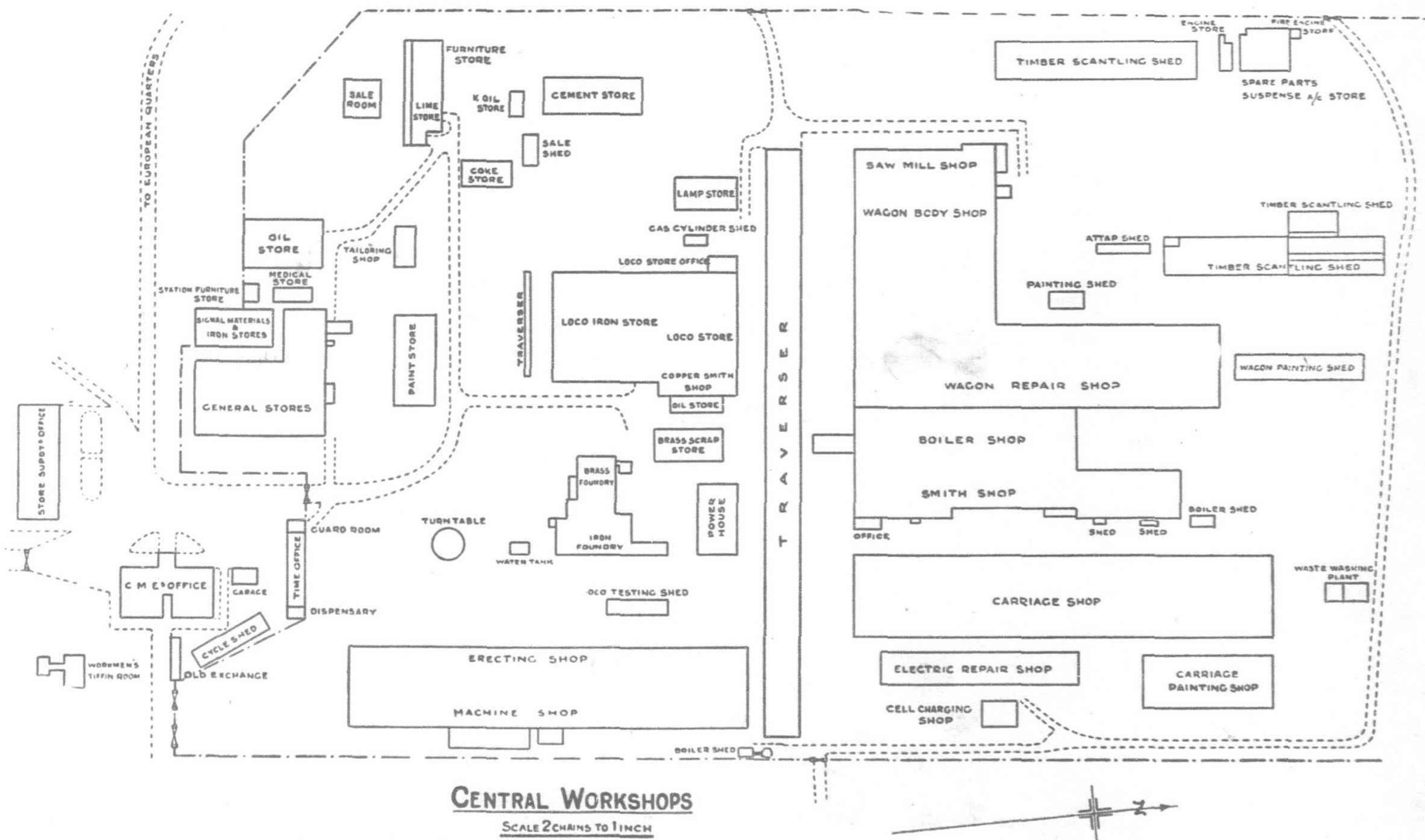
Another Bay of Wagon Shop showing Overhead Travelling Crane



Central Repair Shops of the Perak and Selangor Government Railways in 1906



Aerial view of the Central Workshops, 1935



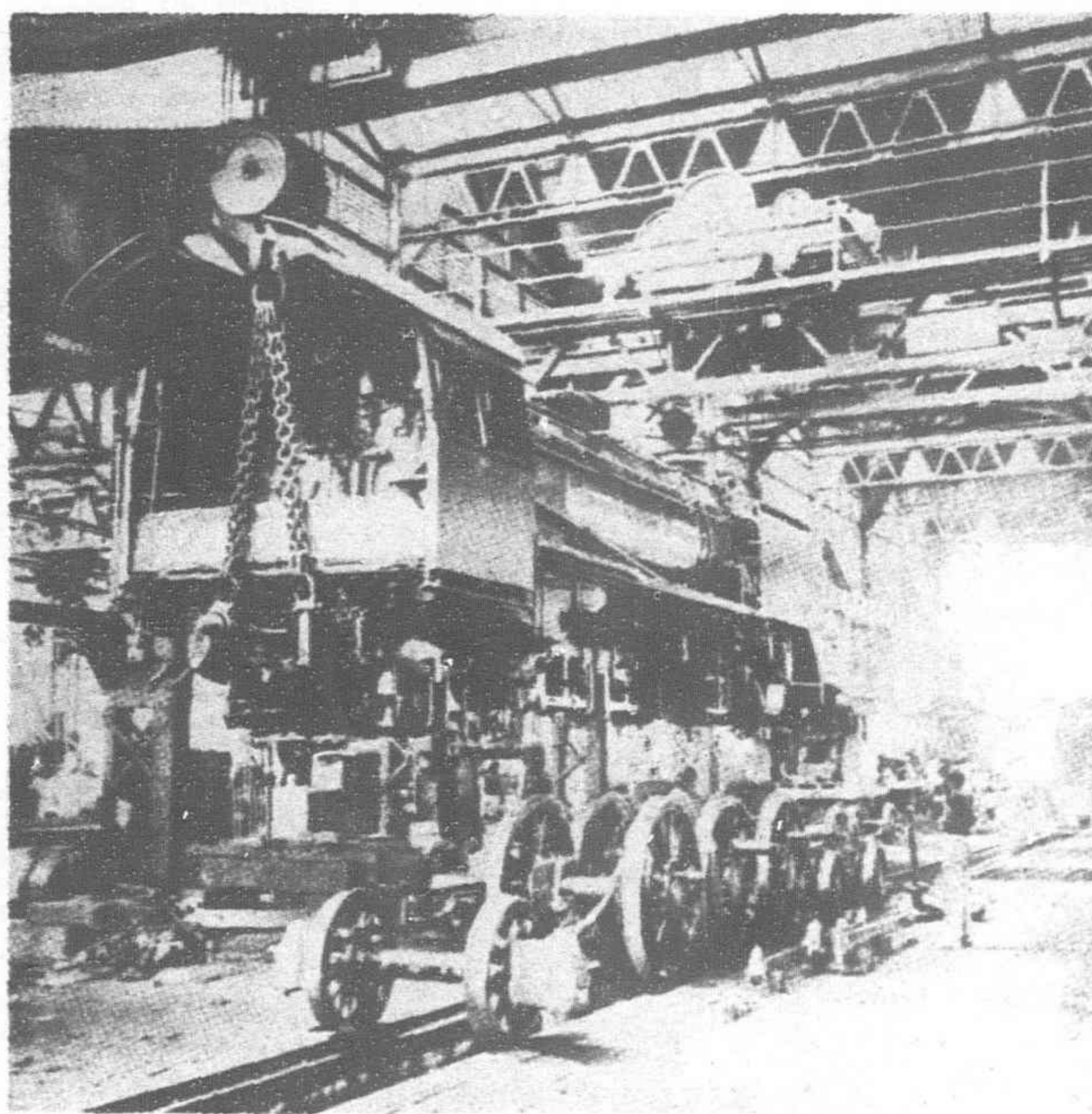
Sketch showing the situation of the several departments of the Central Workshops

being available. The boiler shop is also the welding depôt. Both oxy-acetylene and electric welding is used, but the latter predominates the equipment now employing seven operators.

The smith shop is next to the boiler shop and is the first building on the right in the photograph. The shop has been twice extended and is now approximately 500 feet long. There are eight steam hammers of various sizes, while the spring section is equipped with oil and electric furnaces and hydraulic and steam plant for the various operations of manufacture and testing of rolling stock springs.

In 1916 the new carriage shop was opened. This is a building of two bays, each 660 feet long, but it was not until after the War that overhead electric cranes could be provided. There are two in each bay, each of 15 ton capacity. Modern progressive methods of repair have reduced the number of vehicles under repair to 25 or about 7½ per cent of total stock, and the building is now capable of housing new construction, as many as 30 coach bodies having been built in this shop in a year.

Adjacent is another new building constructed in 1918, which is partly devoted to electrical repair work. Electricity plays an



Erecting Shop—Lowering a locomotive on to its wheels

important part in the maintenance and running of a railway, and when it is realized that nearly 400 electric motors must be kept in good order and that some 350 coaches are electrically equipped with separate dynamos and batteries, it will be obvious that this part of the work assumes some importance. Here, also, is situated an upholstery and fitting shop in which carriage equipment is cleaned and repaired. A paint shop, capable of housing 10 coaches, provides suitable accommodation for the application of final coats of varnish.

To one acquainted with the congested state of the shops in past and more busy years, the most interesting feature about the workshops is the abundance of room which modern methods, such as "sectionizing" and "progressing" of work has secured, thus leaving adequate scope for new work, which further progress along the path of prosperity will require.

Central Workshops provides employment for over 1,700 men, exclusive of clerical staff, of which about 1,100 are Indians and 400 Chinese. This number also includes about 200 apprentices, who receive a full practical training in the trade they have adopted, and also carefully planned theoretical training at night school classes.

The Recent Growth of Japan's Industries

(Continued from page 76)

Railway Company is now organizing a subsidiary company to manufacture oil by this method, while the Mitsui Mining Company and the Japan Industry Company also are contemplating oil manufacture. For the investigation of this method, an expert was sent a few years ago to Germany by the Japan Electric Industry Company.

Ammonium Sulphate Industry

When ammonium sulphate was manufactured, as a by-product of the iron industry, for the first time in Japan in 1905, the annual output was only about 50 tons. But in 1906 the Japan Nitrogenous Fertilizer Company was formed to specialize in its manufacture, which was begun in 1909 in a factory built in Kumamoto prefecture. In 1915 another company named the Electric Chemical Industry Company was added to the meagre list. Suspended importation, however, during the World War gave rise to many companies manufacturing this chemical. To-day, the Daido Fertilizer Company, the Showa Fertilizer Company, the Hokuetsu Hydro-electric Company, the Dai Nippon Artificial Fertilizer Company, the Miike Nitrogen Company, the Sumitomo Chemical Fertilizer Company, the Chosen Nitrogen Company, etc., together with the two companies of older standing, are actively making a speciality of its manufacture. It is also produced as a by-product by the Japan Iron Works, the Japan Steel Manufacturing Company, the Tokyo Gas Company, the South Manchuria Railway Company, etc.

The output rose from 7,000 tons in 1912 to 370,000 tons in 1930, and 600,000 tons in 1931. This was doubled in four years' time, and 1,200,000 tons of ammonium sulphate were produced in 1935. Owing to this amazing increase in production, Japan has not only become self-supplying in this artificial fertilizer, but has now become able to export it in large quantities to other countries.

Japan's ammonium sulphate industry has now entered upon a stage of self-sufficiency, independent of imports. This, being the case, it is not to be doubted that the future of this home industry must be restricted, in a great degree, by the conditions of Japan's agriculture. Extensive development of Japanese agriculture being no longer possible, this industry is, sooner or later, destined to suffer from over-production. Under the circumstances, it must

choose between overseas export and restriction of output. The import and export license system, effective in 1931, is in reality operated at present as a means to license imports and "unlicense" exports. Since, however, the unlicensed export is due to the protection of agricultural people from the disadvantages to be caused by dumping exportation, it is quite reasonable that when the market price is so low as at present, surplus products should be exported, even before the abolition of the import license system. In the circumstances, the exportation of domestic ammonium sulphate will presently be permitted, while it is by no means unreasonable to expect the abolition of the present license system. Nevertheless, with the limited world market and the cost of the product not fitted for dumping competition, Japan cannot take an optimistic view of the future of her export business in ammonium sulphate.

The High-Tension Laboratory of the National Tsing Hua University, Peiping

(Continued from page 77)

current is supplied by a motor-generator with insulated shaft. Variation of filament voltage is obtained by adjusting the speed of the motor-generator.

High damping and discharge resistances are arranged in the surge circuit in order to give the impulse waves the desired form as regards equivalent building-up time and half crest duration. Their ready adjustability led to the selection of water resistances. Each of these consists of two copper cups, each of 300 C.C. capacity and mounted on insulators, forming the electrodes. They are connected by V-shaped glass tubes. If the current loading is heavy the resistance fluid heats up and rises into the copper cups, where it is efficiently cooled owing to the high thermal conductivity of the metal. Hence the resistances can be very heavily loaded.

A second rectifier, set with two valves, supplies high-tension direct current for travelling wave tests. The valves can be connected in parallel or for half-wave, full-wave, or voltage doubling, in the latter instance providing a maximum of 150 kv.

The valves are directly mounted on their filament transformers. Regulation of the filament voltage is given by sliding rheostats in the primaries. Valves, filament transformers, and instruments are installed on a common chassis.

Phases of Tokyo's Municipal Administration

By S. KITAMURA, Harbor Board, Tokyo Municipal Office

THE educational work of the City of Tokyo is divided into two main categories; namely management of schools and social education. The municipal schools consist of numerous primary schools, 76 night schools of primary education, 49 middle schools, 175 young men's training schools, two blind schools and 48 kindergartens. The percentage of children or pupils who attend these schools is about 99.48 per cent of the whole number of children of the city.

Every year, there are about 120,000 children who finish the entire primary course and about 80 per cent enter middle or higher schools while the remainder engage in business.

With the speedy increase of the population of the City of Tokyo, the number of pupils correspondingly increases, and the city is under pressure to provide more than 500 class rooms in primary schools every year. For that reason, the authorities are busily constructing new school buildings. However, this unavoidable crowding is expected to be abolished when the five year construction plan is completed by 1940.

For the purpose of social educational facilities, the city has established 26 public libraries and self-governing halls with the object of fostering an autonomous spirit among the citizens.

Social Work

The most important social service carried on by the city is welfare and shelter work. The former gives necessary assistance to unfortunate people of the various districts of the city. At present, the number of families in need of public help in this city reached 116,000, especially large numbers being found in Arakawa, Fukagawa, Honjo, Asakusa, Joto, Mukojima and Adachi wards.

The city is divided into 118 districts with 2,000 committees which are consulted by the poor people in these districts. The sheltering facilities have a capacity of receiving 2,400 persons and is one of the oldest institutions of social work in the city.

Furthermore, the city has established 24 public welfare houses to prevent poverty by giving suitable knowledge of social life. For instance, it provides night schools, periodical lectures, libraries and answering various questions of citizens regarding health, difficulties in private life and matters pertaining to law.

For the economical protection of the people, the city has now 14 lodging houses, ten of them, with prices ranging from 13 sen to 27 sen for a night, four free of charge, sixteen simple dining rooms, twenty pawn shops, three public bath houses and 2,193 dwelling houses. For the protection of infants or children, the city has established four maternity wards, two infant hospitals and juvenile protection houses which are now showing good results.

The estimated number of unemployed in Tokyo is 65,000 persons altogether. As relief measures for these people the city provides 46 labor exchange offices with five branches as well as six work-giving houses to find work or to accept proposals of employment.

Sanitation and Public Health

The arrangements of sanitation and public health are divided in the following four main groups:—

General equipment for medical treatment: the prevention or suppression of epidemic diseases; the disposal of refuse and garbage; and maintenance of parks and cemeteries.

For the equipment for medical treatment, the city has provided seven hospitals, eight health consultation offices, two trachoma and a parasite medical treatment offices and a sanatorium for children, especially giving medical treatment chiefly to lower class citizens free or at low charges. For the prevention of epidemic diseases, the City has established six hospitals for infectious diseases, three isolation hospitals, six disinfecting stations. For the prevention and the propagation of general health ideas, regular vaccination, injection for preventing infectious diseases, house-cleaning, lecture-meetings of public health and meetings with movies are provided, especially at Nakano Ward, the city has established

a sanatorium for the purpose of protection of tuberculosis and ten health consulting offices in various districts of the city.

Furthermore, the city has established a sanitation hall and a municipal hygienic laboratory. The former is the central organ between citizens and health institutions in Kyobashi ward for the prevention of disease and training of human bodies; the latter undertakes health preservation and various kinds of technical research, scientific and chemical examinations at the request of citizens.

The total amount of garbage produced daily is 1,087,500 kilograms from the old districts of the city and 1,350,000 kilograms from newly added districts. The greater part of this garbage is gathered and carried to the incinerator at Fukagawa to be burned while the remainder is used for reclaiming land.

Parks under control of the city are 148 in number and their total area is about 240,000 sq. meters. There are cemeteries, seven in number, and another municipal crematory is under construction at a site in Edogawa ward.

Waterworks

The present condition of the water supply within the former Tokyo area is adequate; however, it is still insufficient for the newly added districts. Moreover, owing to the rapid increase in the population a shortage of water is occasionally experienced.

From autumn of last year, the city has been undertaking a ten years' building plan with an appropriation of Y.39,500,000 for the establishment of the Ogochi and the Murayama gigantic reservoirs. Furthermore, development of the Edogawa, the Tone River, Arakawa River and the Sagami River is now under consideration.

The system of sewers in the City of Tokyo, both the former and the new districts discharges rain and foul water by natural flow or by means of pumps into underground pipes and conveys it to the municipal sewage disposal plants to be discharged into the sea or rivers after treatment.

A concrete system of drainage for the former districts of the city was started in 1911, but the work completed is 65 per cent, while in the newly added districts the work completed is 45 per cent. The sewerage work is still inadequate; therefore, the municipal authorities are paying keen attention to this problem.

Commerce and Industry

The City of Tokyo chiefly produces manufactured articles. In 1934, the total reached was more than Y.1,415,000,000 in value. The city is not only a consumer, but also the largest manufacturing city in the country.

For the encouragement and protection of its merchants and manufacturers the city has established the Central Wholesale Market to undertake smooth distribution and easy supply of provisions at moderate prices. On the other hand, to control meat sales, a slaughter-house and live-stock market have been constructed and will be opened in the near future.

For the purpose of leadership of and consultation for small traders and manufacturers, the municipal authorities have established an inquiry office to take charge of their management, investigation, arranging facilities for loans and various consultations regarding foreign trade. Due to the remarkable advance of trading relations with Manchoukuo, the city established several branch offices in Yuki, north Chosen, Hsinking, Tientsin and Shanghai, China, to introduce Japanese merchandise abroad.

Tokyo Harbor

With the rapid development and progress made by the City of Tokyo and the increase of population to nearly 6,000,000, the consumption of goods has risen to a corresponding degree. However, the harbor facilities are still inadequate to fulfil its complete function. The Tokyo Municipality, therefore, decided to carry out improvements with an estimated cost of Y.33,000,000 over

the space of ten years, commencing with the year of 1930. At present, about 25 per cent of the work has already been completed. In 1922, the total tonnage of vessels which entered Tokyo Harbor was only 300,000 tons, but after the great earthquake disaster of 1923, the same showed a remarkable increase. Now, the maritime installation of the harbor has accommodation for 34 vessels from 3,000 tons to 6,000 tons each alongside the quays at the same time. When these improvements are completed in 1940, the port will be able to receive 80 vessels of 6,000 ton class at the same time.

The sea within the harbor area was thoroughly dredged. From this dredging there has resulted a vast area of reclaimed lands. The reclaimed lands along the water front of the Tokyo Harbor will be more than 2,000,000 sq. meters and the total area of the reclaimed lands will reach about two times and a half of the entire area of the Shiba ward.

The greater part of this area is as yet untouched but upon the completion of the work, it is expected to become the city's most important commercial and industrial districts.

Communication and Electric Supply

In 1935, the volume of daily average passengers in Tokyo was said to be about 3,757,000 persons. Among this number 27.8 per cent is carried by the government railways, while 21.4 per cent is conveyed by the municipal tramways.

Until 1931, the municipal tramways carried between 31 per cent and 59 per cent of all passengers in Tokyo and fares collected amounted to Y.31,840,000 for a year. However, due to the expansion of the government railways, buses and taxi-cabs, the yearly fares collected amount to Y.18,470,000. Furthermore, the earthquake of 1923 dealt a severe blow to the municipal tramways, but the authorities are continuing their effort for restoration. The municipal motor-bus lines operating distance will be increased to 120 kilometers in the near future.

Regarding the electricity supply of the city, it has purchased electric power from several private companies—Tokyo Electric Light Co., Kinugawa Hydro-Electricity Co., and Nippon Electric Power Co. and supplies it to the citizens. As a part of the restoration of the municipal electric business, the city is planning the construction of a hydro-electric plant.

The City maintained 1,445,000 lights, supplied 62,800 kilowatts of power with a revenue of Y.1,290,000. The city also owns the Electric Laboratory and undertakes various kinds of technical research and spreads electrical knowledge among the citizens.

Civil Engineering Work

At present, there are several kinds of roads in Tokyo that is—state, prefecture and city owned roads. Their entire length is 7,861 kilometers and its area 24,906 sq. kilometers. These roads come under the control of the Mayor of Tokyo and the city is spending a large amount of money for their construction, maintenance and repair.

However, the construction of new streets, paving and widening of them followed the seismic disaster of 1923 and, consequently, brought forth a complete change in street traffic facilities. Before the great earthquake disaster the whole area of roads was 11.3 per cent as against the whole area of the city but now the road area is 19 per cent. At present, the city is responsible for 4,700 bridges. The greater part of wooden bridges in the newly added districts of

the city which were destroyed by the fire of 1923, were rebuilt with fire-proof material while the many bridges of old and poor construction, are either being repaired or rebuilt.

The number of rivers and canals in the city is about 170, while 5,500 water courses are controlled by the Mayor who provides river inspectors and boatmen for supervision and clearance.

City Planning

City planning aims to prevent congestion by giving adequate expansion under scientific leadership and considers the fundamental planning of proper arrangements for various city facilities and equipment.

The Tokyo city planning regions cover an area embraced by a 16 kilometers radius with the Tokyo Railway Station as the center. Within the above-mentioned area, according to the provisions of the law, the authorities assigned several districts—residential, commercial and industrial and also regulate open space area, light and ventilation for the buildings. Furthermore, from the standpoint of prevention of fire and preserving natural scenery, the city designated the fire limits and landscape districts.

Besides, from the view of public health, recreation and city defence, the authorities assigned green land districts which embraces 50 kilometers radius with the Tokyo Railway Station as the center.

Municipal Administration

To control the municipal administration of Tokyo, there are two bodies—the legislative and executive. Members of the City Council, 144 in number, are empowered by election to enact or reorganize city regulations; to make decisions as to budget, to give approval or settle accounts; to impose and collect city taxes, rents and fees and to decide all other important matters of the municipal administration.

The board of Aldermen, elected from members of the City Council, consists of 15 honorary aldermen to whom the Mayor is added as chairman, and deals chiefly with affairs assigned for its consideration by the Council.

The Mayor, who is elected by a vote of the Council, is the executive head of the city administration for a term of four years. He represents the city as a matter of course and supervises the municipal administration.

Under the Mayor there are some 35,000 officials and employees, including three Deputy Mayors who are assigned to respective departments to share in the work of the city administration. Furthermore, the city is divided into 35 wards, under a chief of ward with many officials. Each ward has a ward assembly which is the legislative organ in regard to expression and enforcement of the ward opinion.

Members of ward assemblies, 35 or 46 in number, are chosen by election. In addition to these, there are more than 3,000 street associations in the City of Tokyo.

Inside of the main gate of the Tokyo Municipal Office, there is an inquiry office for the convenience of both foreigners and Japanese tourists or excursionists who desire to obtain facilities in connection with sightseeing in the City of Tokyo or suburbs. Branch offices are now open in Tokyo Railway Station and Ueno Railway Station. In these offices one can get full details and geographical guidance of Tokyo; sightseeing programs, fares of trains; steamers; vehicles, carriages; hotels; or entrance to schools; general conditions of commerce and industry, etc., free of charge.

RADIO TELEPHONE IN JAPAN

Japan's already extensive international network of radio telephone services will be further expanded in the next five years. The Ministry of Communications plans to establish transmitting and receiving stations at Tokyo and Osaka, replacing the present center in Nagoya. The Tokyo equipment will be used for communicating with Europe and America, as well as international radio broadcasts, and the Osaka station will devote itself to the Far East and the South Seas, although it will be able to take part of the European

traffic if necessary. Completion of the two stations is expected by the end of the 1937-38 fiscal year. After that the Communications Ministry plans to expand the nation's radio-telephony network to include direct connections with New York, Canada, Colombia, Peru, Chile, Panama, Belgium, Sweden, Norway, European Russia, Austria, Czechoslovakia, Turkey, Australia, Malaya, Union of South Africa, Egypt, Persia, New Zealand, Siberia, Tientsin, Tsingtao, Hankow, Canton and Hongkong.

Engineering Notes

INDUSTRIAL

TOURIST HOTEL.—In connection with the proposed international tourist hotel, which is to be built in Kobe at a cost of about Y.5,000,000, Messrs. Nishikawa and Kita, of the Kobe Businessmen's Association recently called on Mayor Katsuda and Mr. Uyeda, Chairman of the City Assembly, and submitted a statement asking the co-operation of the city authorities towards quick realization of the scheme.

JAPAN BUYS SCRAP.—Japan has become Ceylon's chief customer for scrap iron, in which the island is doing a growing trade.

Ramshackle motor-cars, lorries, discarded boilers, old cycle frames—in fact, all those things which find their way to the refuse heap, are now being bought by the Japanese and shipped to Japan.

Most of this material, it is believed, is eventually used as fillings for high explosive shells and shrapnel.

PHOSPHATE PLAN.—The Nanyo Kohatsu Gaisha, affiliated with the Oriental Development Company, has decided to exploit the natural resources of the South Sea islands on a larger scale in co-operation with the South Sea Development Company, to be founded shortly. Finding phosphate ores on Ponape, South Sea Islands, promising, the company has decided to mine them. Ore-dressing equipment for 30,000 metric tons a year is to be completed early next year. Nanyo Kohatsu is now mining the same amount on another island of the group.

NEW DYEING ENTERPRISE.—The Asahi Bemberg Company of Osaka has decided to establish a dyeing company with a capital of Y.2,000,000. The plant, will be built in Suita, an Osaka suburb. Asahi Bemberg manufactures acetate rayon, which takes dyes different from viscose. The company will use dyes of the Japan Dyestuff Manufacturing Company and of the I.G. Farbenindustrie. Other chemicals will be made in the plant. Asahi Bemberg is also said to be considering enlargement of its Otsu factory with the idea of making staple fibre and the purchase of a large weaving plant in Kiryu.

COMMUNICATIONS

KANSU-CHINGHAI HIGHWAY.—Kansu and Chinghai were brought close together recently with the completion of the Hengtang-Sining section of the Kansu-Chinghai highway. A test run on the new road was made with satisfactory results.

RADIO-TELEPHONE.—The toll telephone line between Nanking and Hankow constructed by the Ministry of Communications, Nanking, starting from Nanking via Wuhu, Anking, Hukow, Kiukiang to Hankow, covering a distance of more than 1,000 li, is a trunk line of very important nature in the Nine Province Toll Line Network, and has been recently completed.

SHANGHAI-HANKOW RADIOPHONE.—Simultaneous with the inauguration of the Nanking-Hankow long distance telephone service, the Shanghai-Hankow radiophone service was formally made available to the public recently. Testifying to its popularity, the line was busily engaged throughout the first day. It is understood that if this service should prove to be inadequate to meet the needs in the future, long distance telephone lines may also be installed between Shanghai and Hankow.

GIGANTIC STEEL BRIDGE.—With the projected completion of the gigantic Chungcheng steel bridge at Nanchang before the end of November, Kiangsi will witness the inauguration of through traffic between the Chekiang-Kiangsi and the Nanchang-Kiukiang railways on January 1, 1937. Construction work started late in 1934. The bridge is 1,086 meters in length and has 29 arches, its total cost being \$858,000. It is named after General Chiang Kai-shek, president of the Executive Yuan, whose courtesy name is Chung-cheng.

NEW BUS SERVICE.—With a view to facilitating travel in Hopei and Chahar, the Hopei-Chahar Political Council has recently established a bus company with Mr. Yu Chih-chi, Director of the Communications Section of the Headquarters of Pacification Commissioner of Hopei and Chahar, as Director. Some 100 buses and trucks are reported to have been purchased in Tientsin and these vehicles will operate regular services on the newly-constructed highways in the two provinces so as to cover these places which lack railway facilities.

NEW TRANSPORT REGULATIONS.—In order to assist the work of increasing the carrying power of the railways in the U.S.S.R., Mr. Kagano-vitch, whose appointment as Soviet Commissar of Railway Transport was made in February last, has ordered the withdrawal on many trains of the special sleeping-cars. It is considered that the elimination of one passenger train means the possibility of running three goods trains and the latter are greatly needed to transport grain and other commodities from one part of the country to another.

NEW HIGHWAYS.—The improvement of communication facilities in Szechuen has taken a more concrete shape by the recent opening of the newly completed Szechuen-Shensi and Szechuen-Kweichow highways. Meanwhile work on the Szechuen-Hupeh and Szechuen-Sikang highways is being feverishly pushed by the provincial authorities and surveying work on the projected Szechuen-Yunnan and Szechuen-Kansu highways has also been started. Ninety per cent of the construction work of the Szechuen-Hunan highway has been completed. The new line is expected to be thrown open within two months.

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MINING

JAPAN'S TIN MINE.—Japanese interests are negotiating for land in the Kinta area, which is stated to contain 4,500,000 tons of iron ore.

From mines in Johore and Trengganu ore is already being exported to Japan for smelting purposes at the rate of 30,000 tons a month.

MANCHOUKUO GOLD REFINERY.—The Manchoukuo Government Gold Refinery will be built this year at Mukden, the Government having included Y.2,600,000 for the purpose in the supplementary budget. Y.1,600,000 will be devoted to construction and the refinery is expected to refine about Y.4,000,000 of gold a year.

WOLFRAM IN HONGKONG.—The firm of Marsman Investments, incorporated in Manila, has secured rights for the mining of wolfram ore in the New Territories in Hongkong. The Government has signed a 21-year lease, covering approximately 540 acres in Needle Hill.

Under the terms the Government will receive five per cent of the gross output and a royalty temporarily, but the royalty can be revised later by the Governor-in-Council. Geological surveys indicate very large deposits of wolfram ore in the leased sections.

ALUMINIUM IN N.E.I.—In consequence of the rise in world consumption of aluminium, the Nederlandsch-Indische Bauxiet Exploitatie Maatschappij is to add considerably to its bauxite extraction plant. Although exports during 1935 did not exceed 10,000 tons, overseas business showed unmistakable signs of improvement towards the end of the year, and shipments for the last year are expected to amount to between 80,000 and 120,000 tons. The difference between these figures is rather startling, but, in actual fact, 26,500 tons were shipped during the first quarter of last year and the tonnage due for export in the second quarter was 27,500 tons, so that there are reasonable prospects that the optimistic estimates will be achieved.

MAGNITOGORSK PLANT EXPANDS.—Various additions have been made to the plant in the present year and a number of new departments have been opened, including two new rolling mills, an ore-washing and concentration plant, etc. A wire-drawing mill with an output of 220,000 tons is being manufactured abroad and will shortly be shipped to Magnitogorsk.

NICKEL PLANTS.—The nickel industry is one of the youngest branches of Soviet metallurgy. The first plant was opened in the Urals in 1934. It produced 863 tons of nickel in 1935. It was scheduled to produce 1,800 tons last year. The Orsk Plant which is now under construction, will be completely mechanized. It will use the local ore, of which, according to the latest calculations there are over 300,000 tons. This Orsk-Khalilov region (South Urals) present considerable difficulties however, as it is a somewhat poor and moisture-bearing soil.

IRON AND COAL.—It is understood, that it is a prerequisite to the agreement for the erection of an iron and steel foundry in Kwangtung that the British engineering firms of the participating group shall first make a survey of the coal and iron fields of the province. The McKay Co. (?), of Dayton, Ohio, some time ago had experts examine the known veins and were enthusiastic. The largest coal deposit is at Yangmeishan, near the Hunan border, so near that the two provinces disagree as to whether it is north or south of the dividing line.

OIL FROM COAL.—The Japanese Navy, South Manchuria Railway Co., and the Manchuria Coal Liquefaction Industry Co., have jointly decided that a large coal liquefaction factory be built at Tokuyama in Yamaguchi Prefecture at a cost of several million yen. Construction will be started shortly. The South Manchuria Railway also has decided to build a large-scale factory for coal liquefaction at Fushun. The two-year program will cost Y.4,000,000 this year and Y.10,000,000 next year. The plant is expected to be completed in June, 1938.

HSINCHUI COLLIERIES.—To keep pace with the Manchoukuo Government's five year plan of industrial development in the country, the Manchuria Coal Mining Company has established its own five-year plan, increasing its capital to Y.80,000,000. Its coal output will reach 10,000,000 tons annually five years hence, from the present 1,600,000 tons, to meet an increasing demand for coal in Manchuria, and for executing the coal liquefaction enterprise the Japanese Government has outlined as one of its national policies.

ELECTRICAL

LIGHT AND POWER.—The Electro-Chemical Industry Company is to be given permission to develop the water-power resources along the Waka River, and a 15,000-kilowatt power station is expected to be built. Flotation of Y.130,000,000 open-end mortgage debentures by the Ujigawa Electric Power Company has been formally agreed upon. The first lot of Y.20,000,000 was issued on July 25.

PACIFIC RADIO TELEPHONE.—According to an International News Service dispatch, the Washington Government has authorized the Trans-Pacific Communications Company of Dixon, California, a subsidiary of the giant American Telephone & Telegraph Company to inaugurate a direct radio telephone service between China and the United States. The company's engineers are already in Shanghai supervising the technical preparations.

RADIO STATION IN HYOGO.—The new Y.3,500,000 radio receiving station under construction at Onomachi, Katogun, Hyogo, will be opened early next year. Messages from England, Germany and France now being received at Yokkaichi will be received at the new station, as well as messages from India, Syria, Siam, French Indo-China, Java, the Philippines and thirteen other places. Completion of the station will mark the first phase of a program for extensive expansion of communications facilities in Japan.

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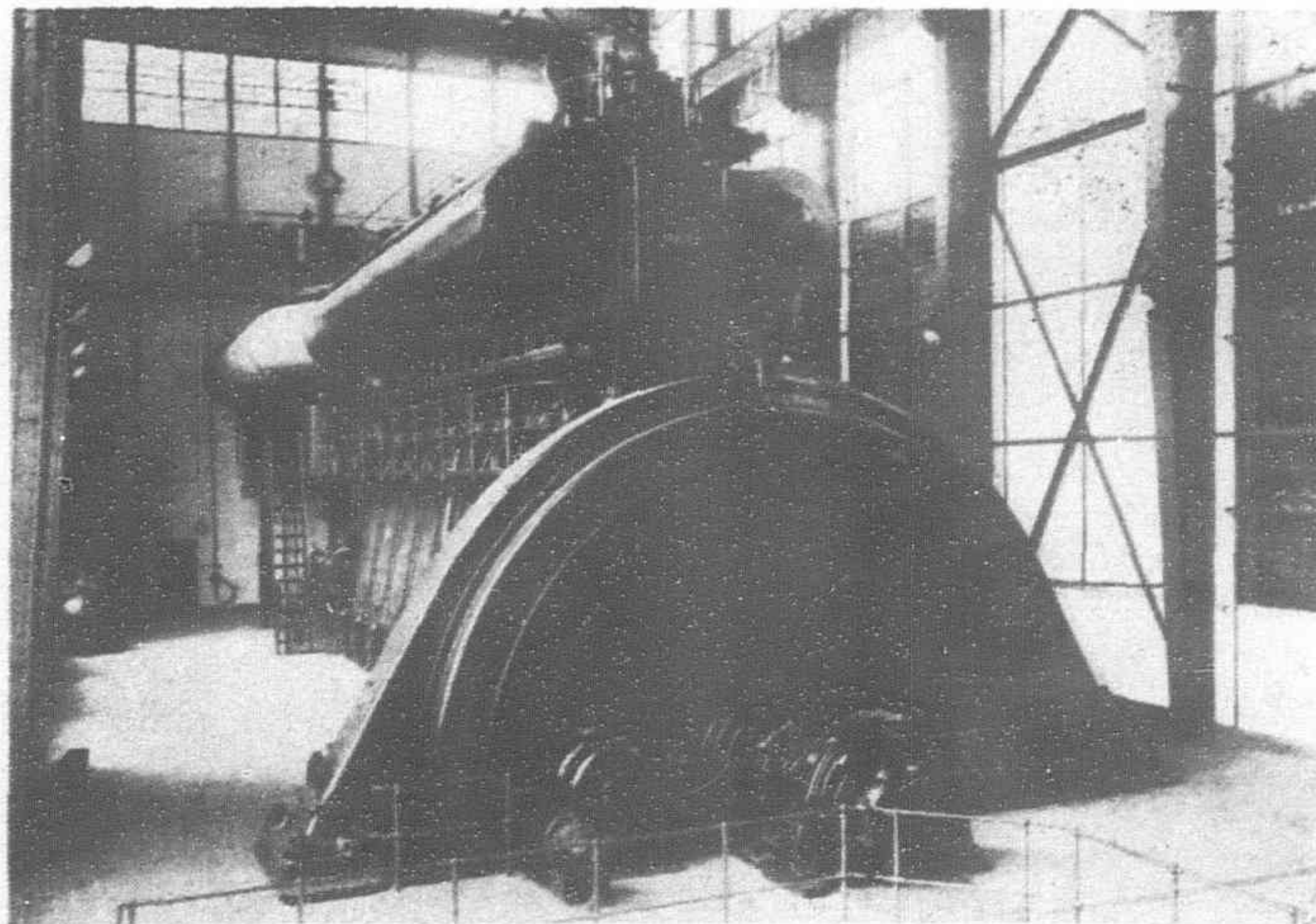
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